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THE STREET RAILWAY INDUSTRY.

Last week we were able to place before our readers the gross statistics of the central station industry, showing an investment in 1907 of a billion dollars and an income of $175,000,000. This week we present on another page the gross statistics furnished by the Census Office for the electric and street railway industry, showing a capitalization of three and three-quarter billions and a gross income from all sources reaching the magnificent amount of $430,000,000. The latter sum includes a large amount from the lighting and power side, the final adjustments for which would bring the light and power income over $200,000,000 and the "trolley" income to $400,000,000, not including the earnings of electrified sections of steam railroads. These totals, gigantic as they seem, are undoubtedly within a small per cent of actual accuracy and represent the reports of the companies themselves. Our readers will note the very close approximation to estimates presented in these pages each year, and especially those just printed. We hope to receive within a week or two the statistics for the telephone art. It would not be surprising if the earnings of that industry came out equal or superior to those of electric lighting, which, of course, is subject to the widespread competition of the isolated plant, a factor virtually unknown in the other two fields. Taking these three great branches, the telegraph field and the product of electrical manufacturing, it will be seen that our estimate of over a billion dollars annually for American expenditure on electrical service and apparatus is easily surpassed, though many have been inclined to doubt it.

Even a superficial study of the two sets of figures reveals many interesting points. The "investment" in central stations is given, but it would seem that the capitalization is about one-third that of the traction art, whose earnings are about two-and-a-half times as great. Per kilowatt-hour of output the contrast is even more striking. With 4,759,000,600 kw-hours the trolleys earned $430,000,000, while with 5,858,000,000 the central stations earned $175,600,000. The central stations have much the larger capacity, as they had in 1902, and now show 2,642,403 kw as compared with 1,727,030 kw for the trolleys. It is a striking fact that in all the broad data, the two industries appear to have doubled in the five years, with the greater gain on the side of electric lighting, due to the fact that it is more closely approximating trac ion as an all-day business.

It is to be noted that a high rate of profit is not discernible from these figures in either group. The central stations operate, roughly, on a 70 per cent basis of expenses, as compared with 60 per cent in the transportation field, but neither ratio leaves much margin to disturb the arithmetic of the U. S. Supreme Court as to the sweet and saving simplicity of 6 per cent. The apparent net income in the lighting field of $41,-000,000 would barely pay 4 per cent on the actual investment, but it is really somewhat higher, as the interest on bonds is

taken into account as an expense; and the total capitalization is not given. It was $627,000,000 in 1902 and was therefore probably over $1,200,000,000 in 1907. In the traction field the outstanding stock was $2,000,000,000 and the dividends were $53,500,000 in round figures, or 2½ per cent. The interest on the outstanding bonds of $1,677,000,000 was slightly over $71,000,000, or less than 5 per cent.

Is There a Power Trust?

The recent veto message of President Roosevelt in condemning the granting of perpetual power privileges on streams under national control, makes certain statements which serve as a basis for the assumption that a formidable water-power trust is in virtual existence. On the authority of Commissioner Smith it is stated that with 5,300,000 hp in water-power plants in the United States, nearly 20 per cent of this amount in plants already developed or advantageous for development, is owned by 13 large companies, who also hold 10 or 15 per cent more by various indirect means. In short, 13 concerns hold about 1,800,000 hp. Proceeding from this basis the President draws the conclusion that a far-reaching power trust is in process of formation, and charges that: "The new legislation sought in their own interest by some companies in the West, and the opposition of other companies in the East to proposed legislation in the public interest, have a common source and a common purpose. Their source is the rapidly growing water-power combination. Their purpose is a centralized monopoly of hydro-electric power development free of public control." This is a pretty serious indictment if well-founded. But what are the facts regarding the alleged ownership?

Is Commissioner Smith prepared actually to state to what extent and just how the big thirteen hold their respective interests? If so he should give the facts the widest publicity. There is no use in mincing words about such matters. We are well aware that there are several large power concerns controlling groups of powers which they have wisely unified into networks with admirable results in ensuring a cheap and reliable power supply. We are also aware that electrical manufacturing companies have been for a decade or more active in selling power transmission apparatus and have helped along promising enterprises in every proper way. Such enterprises go to these concerns for a helping hand very naturally, and have time and again received it in one way or another. The financial allies of the big thirteen have doubtless taken good bonds freely, and have probably had proper representation upon the several directorates. Such assistance has been very potent in promoting the development of water-powers to the great benefit of the territories served. This, however, is a long way from the formation of a water-power trust. It is doubtless unfortunate that hydraulic enterprises have had to go through the financiering process, for, as we have more than once intimated, they have often thereby been burdened with formidable investment charges; yet they have very properly turned first to those who have had faith in the business and the courage of their convictions. If anyone thinks that the big manufacturing companies are jealous and greedy when it comes to independent power plants, let him try going to one of them with a project already organized and with cash ready for the purchase of equipment. He will get a welcome that would have turned the Prodigal Son green with envy.

There is, of course, no doubt that in the past few years people have come to recognize the value of water powers as investments and have taken them up for speculative purposes, but in this there has been no discernible unity of action. So far as we have been able to ascertain, the big thirteen are more jealous of each other than they are of outsiders. Much of what the President takes for concert of action it seems to us is chargeable rather to instinctive community of motive. Financiers always and everywhere can be trusted, secretly or openly, to oppose every form of government control that is likely to hinder their personal schemes. A banker in Maine and a banker in Texas, entirely unknown to each other, will put up the same protest, based on the same old arguments against public control, just as they would probably swear in approximately the same unstudied terms were they severally kicked. We doubt the existence of anything that can fairly be called a power trust, while realizing fully the possibilities of the future situation, and the real need of vigorous action to preserve for future generations their heritage in the hydraulic resources of the country. The government could very properly decline the aid of national resources unless those receiving it directly or indirectly put themselves unequivocally under government rate-regulating power, extending not only to the plant immediately concerned, but to every person or corporation allowed to receive the output for the purpose of selling it again. This would foster combinations just insofar as they might submit to governmental regulation; and such combinations are certainly for the public benefit in the case of electric supply, which comes pretty near to being a natural and useful form of monopoly.

Representation of Synchronous Converter Phenomena.

The actions that take place in a synchronous converter are by no means easy to compute. The machine takes, in general, several alternating currents differing in phase, at its slip rings. It delivers simultaneously a fairly steady direct current at its commutator end, but the actions by which the alternating currents are converted into direct currents, although easy to perceive in broad outline, are hard to represent either diagrammatically or arithmetically. The heating of the armature conductors depends, under the simplest conditions, on the phase relation between incoming currents and voltages, as well as on the amount of load. It is shown by Mr. Olin J. Ferguson, in his article on another page, that the graphic representation of the current strength in the coil of a converter armature is a limaçon, a curve whose properties were first analyzed in publication by the celebrated Blaise Pascal, in 1643. Mr. Ferguson shows that the area enclosed by the curve, when drawn to a suitable scale representing the armature currents, corresponds to the heating in the armature coil considered. This graphical method of representing the action is a distinct step toward simplifying the explanation of a converter's behavior. The area enclosed by the whole limaçon, or by any assigned polar portion thereof, happens to be capable of simple numerical expression.

Regulation of Rates.

The decision of the United States Supreme Court on the 80-cent gas law, affecting the Consolidated Gas Company of New York, is one that is likely to have far reaching effects in every branch of public corporate service. Particularly it is likely to

stimulate efforts at the control of rates hitherto checked by the probability that laws providing for regulation amounting to anything would be declared unconstitutional. Looking at the matter broadly, it is practically inevitable that regulation should come unless the place should be taken by municipal ownership; and of the two, regulation is no more to be feared by corporations and much less to be feared by the public than the alternative. The record of municipal government in American cities is too sinister to encourage any excursions into new fields of graft. As we have several times noted, the crucial point in municipal work is the proportion of politically active employees that a given branch of service is likely to demand. Municipal water works, for instance, generally do well, municipal gas works and electric light works rather badly, and Heaven help us if it comes to municipal tramways. The average street department is hard enough to keep out of mischief, but a street railway system is in a class by itself. The present decision, coupled with common knowledge of the difficulties of municipal ownership, practically ensures the continuance of a tendency toward regulation rather than anything more radical, for which even those regulated should be thankful. The decision also is rational in that it does not neglect the value of franchises as an element in the legitimate valuation of the property. On this point there has been a good deal of debate among publicists, some taking the view that a franchise issuing from the public was not a proper corporate asset in determining suitable prices.

A fairer and broader view it seems to us is that foreshadowed in this decision, that a franchise to do public work is "property and cannot be taken away and used by others without compensation. The important question is always one of value." A franchise becomes of actual value only when it is intelligently utilized, as it can be by good business management. From this point of view the corporations are virtually partners of the public in the values derived from franchises, the corporations being entitled to earnings based on their skillful use of the franchise, which gives it its value as an asset and the rights of the public being fully recognized in the right of regulating rates. It is only in virtue of operation under a public franchise that such regulation is defensible. So far as the physical assets of a gas or electric light company are concerned they are, as far as public rights are concerned, like a foundry or a shoe factory. It is only in the franchise rights that public and private interests find a point of contact. Therefore, if there is to be regulation of rates the value of the franchise is its logical reason for being, and should be taken into account as part of the property on which fair earnings are to be allowed. And the decision under discussion intimates pretty strongly that rates which, based on a valuation including this franchise value, give a return comparable with that of other first-class securities, will not be considered as confiscatory. On physical valuation alone the rate, low as it is, would give a net return larger than would ordinarily be expected from stable securities. The effect of the ruling on the public mind should be to encourage a feeling of fair play toward public enterprises, making it evident that the highest court is disposed to interfere if necessary in the interest of fair play.

The general public ought to realize far better than it does that most public service corporations are disposed to deal squarely, and that impudent grasping is the exception rather than the rule. Few people are in business for their health alone and fair returns upon investments are to be expected. Why should people expect gas or electric light to be supplied at cost instead of on a profitable basis like hats, shoes, flour and pork? And why should they insist on trying to regulate to a nicety the basis of sales of the former commodities without in the least understanding the basis of the business? The thing to be feared in public regulation of rates is not regulation itself, but ignorant meddling irrespective of the necessary conditions of trade. The cost of production of a commodity is brought to a minimum that will ensure low price to the consumer only by the exercise of extraordinary judgment in meeting the conditions of consumption in such wise as to best utilize the plant, whether it is making ice or kilowatts. But people who tinker with rates too often forget everything about details of manufacture and sale and set up conditions that, by increasing the cost of production, may and often do defeat the very reductions in price that are to be desired. In the electric supply business in particular it takes the wisdom of the serpent to work out a system of selling that will tend to minimize the cost of production and hence to lower prices. In the long run the tendency of prices for light and power has been steadily downward in the past while the prices of most things, necessities and luxuries alike, have for years been very conspicuously upward. We have never heard of a place where an electric light company has deliberately raised its prices, and we never expect to hear of one unless in some rare instance where there may have been for a brief period cutthroat competition. On the other hand, the lowering of prices is very common both in the case of gas and of electricity.

Regulation of rates is becoming popular, however, and it will probably continue. Whether it will do harm or good upon the whole is a matter not of principle, but of practice. If approached in a spirit of fair play for everybody, the desired result can generally be reached without much difficulty. If, on the other hand, the problem is tackled by doctrinaires who know nothing of the technique of the situation, or by demagogues who are merely looking for a little cheap notoriety, there is likely to be trouble all along the line. Practically very few bills for the regulation of rates appear to have been drawn by those who have knowledge of the conditions involved and of the real effect of the various provisions. There is too much of the lawyer and the politician and too little of the business man in the game as it is generally played. The relations of the public and the public service corporations ought to be of the simplest and most friendly kind, and to be settled on a strictly business basis, recognizing the rights of both parties; instead of this, they too frequently approximate a game of poker played by eminent counsel with the interests of the public and of the stockholders as chips. Call the determining body by what name you will, its decisions are seldom based openly on what common, everyday people would call a square deal. Even boards of arbitration, which in theory ought to do the work admirably, are often so beset with obstacles that they can make but small progress, and have insufficient authority to enforce the faithful carrying out of their judgments. And so, as in the case before us, the issues get pushed to the court of last resort. Even so, one may be thankful that a tangible issue was actually decided and not deftly sidestepped by a decision based on inconsequential technicalities. For what we have received may we be as thankful as circumstances permit.

President Roosevelt Attacks Electrical Corporations.

President Roosevelt in vetoing a bill authorizing the construction of a dam across the James River, Missouri, for the purpose of electric power, made the following statement:

"The total water power now in use by power plants in the United States is estimated by the Bureau of Census and the Geological Survey as 5,300,000 hp. Information collected by the Bureau of Corporations shows that 13 large concerns, of which the General Electric Company and the Westinghouse Electric & Manufacturing Company are most important, now hold water-power installations and advantageous power sites aggregating about 1,046,000 hp, where the control by these concerns is practically admitted. This is a quantity equal to more than 19 per cent of the total now in use. Further evidence of a very strong nature as to additional intercorporate relations, furnished by the bureau, leads me to the conclusion that this total should be increased to 24 per cent; and still other evidence, though less conclusive, nevertheless affords reasonable ground for enlarging this estimate by 9 per cent additional.

"In other words, it is probable that these 13 concerns directly or indirectly control developed water power and advantageous power sites equal to more than 33 per cent of the total water power now in use.

"This astonishing consolidation has taken place practically within the last five years. The movement is still in its infancy, and unless it is controlled the history of the oil industry will be repeated in the hydro-electric power industry, with results far more oppressive and disastrous for the people. It is true that the great bulk of our potential water power is as yet undeveloped, but the sites which are now controlled by combinations are those which offer the greatest advantages and therefore hold a strategic position. This is certain to be strengthened by the increasing demand for power and the extension of long-distance electrical transmission.

"The great corporations are acting with foresight, singleness of purpose and vigor to control the water powers of the country. They pay no attention to State boundaries and are not interested in the constitutional law affecting navigable streams, except as it affords what has been aptly called a 'twilight zone,' where they may find a convenient refuge from any regulation whatever by the public, whether through the national or the State governments."

An officer of the General Electric Company has issued the following statement in denial of the charge so far as that company is involved:

"The General Electric Company is not a party to any trust to control water power, nor is it to any considerable extent interested in water power through ownership thereof. It is interested in the development of water power as the latter affords a market for electrical apparatus, of which its manufactures largely consist.

"The General Electric Company has no interest in the Westinghouse Company, in the ownership or development of any water power, nor do the men named, so far as I know, control any water power in the interests of the General Electric Company. I do not know of a single water-power company controlled by the General Electric Company, except the power at Schaghticoke (the Schenectady Power Company), all of which power is delivered to the Schenectady plant of the General Electric Company."

Latest Statistics of Electric Street Railways.

Herewith are given the statistics just issued by the U. S. Bureau of the Census for street and electric railways for 1907, for the United States, exclusive of Alaska, Hawaii, Philippine Islands and Porto Rico. The final report now in preparation will contain a complete analysis of these totals and will present detailed statistics for other branches and phases of the industry; for instance, the gross income below companies' earnings from electric light and power, which may easily reach $20,000,000 or more.

The statistics relate to the years ending Dec. 31, 1907, and June 30, 1902. The totals include, as noted, reports of operating and lessor companies and a considerable number of electric light plants operated in connection with electric railways, but do not include reports of railways under construction during the census years; nor do they include reports of financing companies which were not engaged in actual operation of railways or light plants.

	1907.	1902.	Per cent of increase.
Number of operating and lessor companies	1,236	987	25.2
Length of line (first main track), miles	25,547.19	16,651.58	53.4
Total length of single track, miles	34,403.56	22,576.99	52.4
Number of cars, total	83,641	66,784	25.2
Passenger	70,016	60,200	16.1
All other	13,625	6,494	109.8
Number of power houses	624	605	2.7
Steam and gas engines (including turbines), number	2,552	2,351	8.5
Horse-power	2,384,518	1,300,058	83.4
Water wheels, number	228	160	42.5
Horse-power	91,961	49,303	86.5
Total kilowatt capacity of dynamos	1,727,030	898,362	92.2
Output of stations, total kw-hours	4,759,130,100	2,261,484,397	110.4
Passengers carried, total	9,533,080,766	5,836,615,296	63.3
Fare	7,441,114,508	4,774,211,904	55.9
Transfer	1,995,658,101	1,062,403,392	87.8
Free	96,308,157	*	...
Total car mileage (passenger, express, freight, etc.)	1,618,343,584	1,144,430,466	41.4
Condensed income account, operating companies.			
Earnings from operation	$418,187,858	$247,553,999	68.9
Income from other sources	†11,556,396	2,950,628	291.7
Gross income	429,744,254	250,504,627	71.6
Operating expenses	251,309,252	142,312,597	76.6
Net earnings (earnings less operating expenses)	166,878,606	105,241,402	58.6
Gross income less operating expenses	178,435,002	108,192,030	64.9
Deductions from income (taxes and fixed charges)	138,094,716	77,595,053	78.0
Net income	40,340,286	30,596,977	31.8
Dividends (operating companies only)	25,558,857	15,882,110	60.9
Surplus	14,781,420	14,714,867	0.5
Capitalization, operating and lessor companies.			
Capital stock authorized, par value	$2,508,054,336	$1,529,199,589	64.0
Capital stock outstanding, par value	2,097,708,856	1,315,572,960	59.5
Dividends on stock	53,589,399	33,039,171	62.2
Bonds authorized, par value	2,319,220,837	1,341,429,727	72.9
Bonds outstanding, par value	1,677,063,240	992,709,139	68.9
Interest on bonds	71,468,788	43,578,961	64.0
Total par value stock and bonds outstanding	‡3,774,772,096	2,308,282,099	63.5
Employees and wages, operating companies.			
Salaried employees, number	11,700	7,128	64.1
Salaries	$12,909,466	$7,439,716	73.5
Wage-earners, average number	209,729	133,641	56.9
Wages	$138,081,633	$80,770,449	71.0

*Not reported separately.
†Includes $3,255,618 income from interest on bonds and dividends on stock of other electric railways.
‡Includes permanent and other investments, such as securities of other electric railways, treasury stocks and bonds, gas plants, etc.: 1907, $388,394,092; 1902, $152,513,997.

The averages shown by the data embodied in the report are as follows:

Capital liability per mile of track	109,719	$102,240
Average horse-power per engine	934	353
Average horse-power per water wheel	403	308
Kilowatt capacity of engines and water wheels	1,847,453	1,006,623
Kilowatt capacity of dynamos	1,727,030	898,362
Kilowatt consumption per car mile	2.94	1.97
Fare passengers per mile of track	216,286	211,464
Fare passengers per car mile	4.60	4.17
Income per car mile	25.8c.	21.6c.
Average yearly salaries of officials	$1,103	$1,044
Average yearly wages of wage-earners	$658	$604

Niagara Power Treaty.

Secretary Root and Ambassador Bryce, of Great Britain, have signed a treaty for the settlement of differences between this country and Canada relating to Niagara Falls and the Great Lakes. The treaty requires that the level of Lake Erie must be maintained, and permits Canada to use for power purposes at Niagara 36,000 cu. ft. of water per second, and fixes the amount for the United States at 20,000 cu. ft., an increase of 1500 cu. ft. over the amount recommended by the International Waterways Commission, whose figure for the Canadian falls was accepted. The treaty provides for a commission to dispose of future problems that may arise in administering its provisions. As the level of Lake Michigan is not specifically fixed, the status of the Chicago drainage canal is not affected by the treaty.

Massachusetts Legislative Notes.

A bill has been introduced into the Massachusetts Legislature authorizing the Massachusetts Highway Commission to require, in cases where it considers it necessary from the standpoint of safety, street railway, telephone, telegraph, electric lighting and other corporations using overhead wires and trolleys, or other conductors, to place all such wires underground, in conduits, by 1914, in all cities and towns with a population of over 25,000, and by 1915 in all other places in the State.

The United Electric Light Company, of Springfield, has petitioned the Massachusetts Legislature, and a bill has been introduced to the effect that the company shall not be required to place in more than one mile of streets its wires and cables underground in each year, beginning in 1909.

Hartford Street Lighting Proposals.

The Hartford Electric Light Company has submitted proposals for street lighting to the city authorities under date of Jan. 4 in accordance with the specifications prepared by Dr. Louis Bell, of Boston, consulting engineer. The company proposes to light the streets for a term of five years as follows:

a. By arc lamps of the titanium type, taking not less than 4 amp, and not less than 300 watts at the arc, at $64 per lamp per year, if supplied from the underground system, and at $60 per lamp per year if supplied from the overhead system.

b. By arc lamps of the magnetite type, taking not less than 4 amp and 300 watts at the arc, at the same prices.

c. By tungsten lamps, taking about 250 watts at the terminals and operating at a specific consumption of about 1.25 watts per candle, at $35 per lamp per year if operated from the underground system, and at $30 if run on the overhead system.

d. By tungsten lamps of 125 watts, 1.25 watts per candle, at $17 per lamp per year, operated from the overhead system.

e. By tungsten lamps of 75 watts, 1.25 watts per candle, at $15 per lamp per year, operated on the overhead system.

f. By tungsten lamps of 50 watts, 1.25 watts per candle efficiency, at $14 per lamp per year, overhead system operation.

g. By tungsten lamps of 40 watts, 1.25 watts per candle, at $13.50 per lamp per year, operated from overhead system.

For the present system of street lighting which the company has been supplying for the past five years to the city, the company bids as follows: For each arc lamp, $56 per lamp per year for a period of five years; or $60 per lamp per year for a one-year contract, the lamps being either 6.25-amp series alternating-current enclosed arcs, or 4-amp direct-current constant-potential enclosed arcs. The lighting committee has taken the bid, which was the only one offered, under advisement.

Enlarging Chicago Drainage Canal Power Plant.

Contracts were awarded on Jan. 15, by the Sanitary District of Chicago, for a generator and six large transformers, which will be used to increase the equipment of the Drainage Canal power transmission from Lockport, Ill., to Chicago. The contract for the generator went to the Western Electric Company for $25,748, and calls for a 4000-kw, 60-cycle, 6600-volt, three-phase machine to be delivered June 1 next. It is only comparatively recently that the Western Electric Company has gone into the building of alternators, and this will be the largest machine it has turned out.

Mr. W. A. Jackson, a contractor, received the transformer contract, his bid being $18,500. He will use General Electric transformers. Three will step-up the generator voltage to line voltage (44,000 volts) and three will step-down the line voltage at the Chicago substation to primary distribution voltage (12,000 volts).

At present the working capacity of the power house at Lockport is 12,000 kw in three Crocker-Wheeler units of 4000 kw each. Two other units of the same size and make will be put into service soon, however, so that when the Western Electric machine is added in the summer the total rating of the plant will be 24,000 kw, or just double its present capacity. Specifications for meters and transformers for distribution and customers' circuits are now out. Mr. E. B. Ellicott, Sanitary District, Chicago, is the electrical engineer.

Another Patent Fraud Case.

On Jan. 12 Mr. Chas. E. Acker, of the late Acker Process Company, Niagara Falls, was indicted at Lockport, N. Y., for alleged fraud in connection with an application for a United States patent on a process for removing tin from tin scrap by means of chlorine gas. The indictment contains four counts, one for perjury and three for subornation of perjury. The case against the accused was worked up by the owners of patents which, it is alleged, the former endeavored to supersede by securing a subsequent patent on the process that it covers, but having behind it an earlier date of conception of invention. Copies of the indictments in the case applied for have not arrived as we go to press, and in the absence of a statement from Mr. Acker, at present only the side of the prosecution can be presented.

The indictment at Lockport was secured through the efforts of the Goldschmidt Detinning Company, of Chrome, N. J., which owns U. S. patents granted to Karl Goldschmidt and Josef Weber, of Essen, Germany, on detinning scrap tin. To these, as joint inventors, a patent was granted (No. 882,115) on a process for removing by means of chlorine gas tin from tin scraps, and a further patent on Sept. 8, 1906 (No. 831,223), on a modification of the same process. It is claimed that within three weeks after the issue of the first patent Acker filed an application in the patent office covering the same subject as that of the patent, and within three weeks after the issue of the second patent he filed an amendment to this application which contained, word for word, as well as the punctuation, 14 of the 16 claims of the latter. This was followed by interference proceedings on the claim that Acker had anticipated Goldschmidt and Weber in the invention at issue. Under the U. S. patent laws a foreigner is limited in date of invention to the date on which a corresponding patent in his own country was published, whereas a domestic inventor is allowed a latitude of two years or more prior to date of application. In the interference proceedings Acker filed a sworn statement to the effect that he invented the chlorine process of detinning at issue early in the year 1902; that early in December of that year he demonstrated the practicability of his invention in the laundry of his house in Niagara Falls; that he continued his experiments on an average of at least once a week at the same place until Christmas of 1902, and thereafter in the basement of the works of the Acker Process Company at Niagara Falls until April or May, 1903, after which the apparatus was returned to the cellar of his home, where he worked on the invention at least once a week until February, 1906. Four witnesses testified in support of this statement.

The complainants maintained that upon investigating the statement, they found first, that not one of the servants employed in Acker's house during the period mentioned knew anything of any chemical operations being conducted in the laundry, though one of the witnesses being a man who took care of the furnace in the residence during the larger part of the period named. It is further alleged that after the cross-examination by the complainants of this latter witness, the accused offered a bribe to have him make certain statements on the stand which he himself would there corroborate. A laundress also testified that she was approached by Acker with a view to having her testify as he wished. Three witnesses had given testimony that they had assisted in the operations in the laundry, but it is stated that when the district attorney sent for these witnesses and questioned them they confessed that the testimony given by them was false, and made a like confession later in Patent Office proceedings. After careful consideration of the allegations of fraud final judgment was rendered against the Acker application.

Public Service Commissions and Electrical Engineering.

At the meeting of the Pittsfield, Mass., section of the American Institute of Electrical Engineers, held there on Jan. 8, Mr. T. C. Martin, editor of *Electrical World*, delivered an address on "Public Service Commissions and Electrical Engineering." He pointed out that the relationship of these new bodies and of the newer legislation to engineering was very close and intimate and must affect its future deeply. Such bodies, indeed, would not exist but for the work of the engineers and inventors, who had given us the modern arts.

If, however, in acquiring these material benefits we had lost any of our real personal freedom and political liberty, the whole lot would not be worth the having. If the rights of individual citizenship are under doubt of curtailment, it would be better to go back part of the road of civilization and travel slower or enjoy less light; for the sake of being unhampered by the fetters of our own luxuries. The assumptions of recent years have been, in some quarters, that we had paid in this sacrificial manner too high a price for what we got, and should rather look on Watt, Smeaton, Franklin, Stephenson, Bell, Edison, Elihu Thomson, W. Stanley, S. D. Field as enemies of their kind rather than as benefactors, because their ideas constitute the basis of monopoly. It is true these names are not pronounced loudly, or are hardly heard at all, in the storms of popular declamation that beat so strenuously on weary ears, but take them away and there would have been no need for "control." President Roosevelt could have gone to Africa for his big game seven years ago; there would have been none in this country.

Mr. Martin remarked that the public service policy was not altogether a novelty. Such bodies of limited scope have existed for many years in the various States; while the Interstate Commerce Commission is but another illustration of the applied idea on a larger scale. In fact, a vast body of legislation existed before these commissions came into being that dealt with the regulation and control of public service corporations, and all of that legislation has had to be repealed. Thus the law in New York repealed 10 previous laws by name, as well as those unnamed. The draft of the bill embodying the proposed law for Connecticut repeals by name no fewer than 16 chapters of the laws of various years and several scores of sections of the general statutes. These facts show simply what is perhaps well known to many, viz., that legislation of this kind is not a novelty. What does constitute the novelty is the amplitude given to the powers of these commissions over practically all the functions of the public utility corporations; and it was in relation to some of these delegated powers of the States that he proceeded to speak more specifically, dealing both with the laws and what has happened under their application.

We have to-day two Public Service Commissions in this country, New York and Wisconsin; but in New York the work has been divided between two bodies, and in Massachusetts there are three commissions which cover the same ground as the one commission does in Wisconsin. Outside these States the question of establishing such a commission is very seriously proposed, as, for example, in Ohio. Bills have been introduced in the last Vermont Legislature aiming at the same object. Other States, like New Jersey, have had the matter under agitation, and it really looks as though in a few years Public Service Commissions of the New York and Wisconsin type would become quite general throughout the country. Moreover, the drift of public opinion is also toward inclusion of all utilities and to wider powers over capitalization. Thus in national control, Senator Dolliver has introduced a bill this winter at Washington regulating closely the issuance of securities by steam railroads and putting telegraphs and telephones under the Interstate Commission. President-elect Taft is understood to be framing up changes in the law which will give the commission and the Bureau of Corporations very broad powers over all companies doing an interstate business. In New York State it is now proposed definitely to put the telegraph and telephone companies under the two commissions; and in the outlined Connecticut scheme all water, water-power and express companies are to be included. It is thus very evident that we are rapidly passing to a further stage of evolution of the public utility corporation, while each step raises questions of the most vital importance to all.

It is, of course, with regard to railroads that State regulation has gone furthest, and a brief summary of the facts as to that one department of activity will not be without interest. In 1902 there were already no fewer than 31 State railroad commissions; there were in 1908 eight more, making a total of 39, to which perhaps one or two may have been added during the year. Seven of the commissions were replaced by other bodies, so that in the five years 15 new commissions were appointed. These 39 are not all alike, some being "weak," as they are called, without power to fix rates, and others "strong," i.e., possessing the rate-making power. Of such a "strong" character are the commissions of New York, Ohio, Wisconsin, Colorado, Michigan, Nevada, Oregon, Vermont; but there are some which go further, and do not merely regulate rates, but themselves make complete rate schedules for State traffic on their own initiative. These commissions exist in Indiana, Washington, Montana, Nebraska and Alabama. "Weak" commissions without mandatory power over rates are found in New Jersey and Pennsylvania. The body in Pennsylvania has jurisdiction, however, over navigation companies, pipe lines, and telegraph and telephone companies. The Kansas commission has control over electric railways. The Georgia commission now has enlarged powers which really make it a public utilities commission, as it includes street railways, gas works, and electric light and power companies. This brief and necessarily incomplete summary gives an idea of the varied manner in which this great modern problems of adequate but reasonable control has been approached.

Mr. Martin quoted President Humphreys, of the American Gas Institute; President Farrand, of the National Electric Light Association, and Mr. T. N. McCarter, past president, American Street & Interurban Railway Association, to show in what language of distrust and deprecation these leaders of great public utility groups regarded the various efforts of the new commissions to enlarge their powers and aggrandize themselves. He then spent some time in showing how rates were affected, and referred to rulings and regulations as to lamps, meters, rates, breakdown service, accounting and other elements into which electrical engineering entered more or less deeply. He showed that already there were differences of practice, which would probably become greater as these new bodies increased in number. At the same time there might be advantage in having these various "experimental stations" and "testing laboratories" for the era of regulation was upon the art, and the best methods could be found none too soon.

What the Wisconsin Utilities Commission Has Done.

In a recent address before the National Municipal League and the American Civic Association, Dr. B. H. Meyer, president of the Wisconsin Public Utilities Commission, summed up the benefits of the work of that body as follows:

1. The Wisconsin legislation has taken the utilities, as well as the railroads, out of politics. I do not believe that many citizens can be found in the State of Wisconsin who would seriously claim that in either the primary campaign or in the campaign preceding the present November elections, the utilities as such had entered into politics. All students of municipal affairs well know that in this elimination of politics from the management of utilities we have removed one of the greatest and most persistent sources of corruption and bad government.

2. The utilities law tends to eliminate feuds between the citizens and the managements of public and private plants. The law assures to all communities good service at reasonable rates. This is placed within the reach of all impartially.

whether the commission advances or lowers the rate. The basis of its findings is published in every instance. These published facts should suffice to convince, and I believe do convince, the average citizen of the reasonableness and justice of the decision, if it is reasonable and just, and whether he likes it or not, he must abide by that decision. In this respect, cases affecting utilities are quite different from the most of the cases affecting railroads. In the case of utilities the controversy frequently degenerates into a bitter and partisan feud, affecting the entire population, which blinds both sides to a proper comprehension of the facts and to a sense of justice. Proceedings before the commission tend to clarify and educate public opinion.

3. The public utilities law raises the standard of morality through the eradication of the evil of discrimination, and the protection of a reasonable rate. To those who are quite familiar with the past evils of discrimination in railway rates, the extent of the discriminations in the rates in service utilities may be almost beyond comprehension. The whole State of Wisconsin was literally streaked and plastered with discriminations in the rates of utilities, and in all the rest of the country where the extent of such discriminations have not yet been determined, as they have been in Wisconsin, it is quite probable that discriminations similar in character and extent likewise exist. All rates, rules and regulations in effect in the State are on file with the commission, and these are the only rates and regulations which can be lawfully enforced and collected. Free and reduced-rate service has been absolutely prohibited. Thousands of individuals had been receiving free and reduced-rate service, and eradication of all such rates cannot help but serve as a moral tonic and raise the level of public and private morality within the State as a whole. For 32 of the reporting telephone companies, eight of every 100 subscribers received free or reduced-rate service. The process of equalization of rates had been going on for over a year. Consequently the actual extent of the unjust discrimination was doubtless very much greater at the time of the enactment of the law. I have every reason to believe that in every other State of the Union these discriminations still flourish at the expense of subscribers who pay the full rate. Similar discriminations exist in other classes of utilities.

4. The utilities law is working a revolution in business management. While some managements are doubtless models from a business point of view, they are not the general rule. Many of the utilities companies have not been operated on a business basis; in fact, it is probable that a good many of the managements did not have the remotest idea as to the exact standing from a business point of view of the plant they were operating. Uniform accounting, rules governing the service and the regulation of rates compel the adoption of business and scientific methods, which is resulting in nothing short of a revolution in management.

5. All of the effects of the law, taken collectively, are bound to place investments in public utility enterprises on a more stable foundation. The law works both ways. On the one hand, it protects the consumer against unjust and unreasonable rates and poor service, and, on the other, it protects the investor in his claim to a reasonable rate on the property which is devoted to public use. This legislation will probably remove public utility investments very greatly, if not entirely, from the field of speculation and place them in the class of conservative, certain and stable investments.

A Report on Methods of Telephone Accounting.

A report has just been filed with the city of Chicago by the engineering firm of D. C. & W. B. Jackson, and Arthur Young & Company, the consulting accountants for the city, with regard to proposed methods of accounting for the telephone system. Interest attaches to the subject from the similarity developed to the methods employed in arriving at the cost of other electrical service. The proposed new telephone ordinance reserves to the City Council comprehensive powers in the adjustment, changing and regulation of telephone rates after 30 months from the company's acceptance of the ordinance, which was Dec. 1, 1907, and thereafter at intervals of five years. For the purpose of an intelligent exercise of the right to regulate rates at the end of 30 months it is considered important that the information produced for the city shall particularly exhibit: (1) the investment required for furnishing each class of telephone service; (2) the cost of furnishing each class of service rendered, and (3) the revenue derived from each class for service rendered. The ordinance clothes the city comptroller with authority to prescribe the form and manner of keeping accounts and records by the company, and the report is in conformity with this authority. The object of the report is to formulate a system of keeping records and accounts to be adopted by the telephone company so that all the facts, data and information necessary to make proper and reasonable regulation of rates may be furnished to the city.

A more comprehensive system of record keeping and accounting than has heretofore been introduced by any telephone company is required to make apportionment of costs among the many different classes of service established by the ordinance, and this report is in a sense without the guide of precedent. To accomplish the purpose, the costs of giving service must be separated and properly apportioned among the different classes of service. The rate schedule of the ordinance requires the company to maintain a comprehensive service suited to all classes of users, which analyses into 15 different classes of service for "Chicago Exchange" users, seven classes of service for "Neighborhood Exchange" users, and two special classes embracing private lines and mileage extension lines. These are enumerated in detail in the report. They are all for service within the city. Toll service to points outside of the city is additional thereto.

The city probably will eventually desire to have a complete inventory and appraisal of the physical property of the telephone company. However, the plan of accounting laid out in the report expects that suitable subdivisions of the plant may be reached through accepting the divisions found in the telephone company's accounts, and deriving the further subdivisions by mathematical processes and engineering estimates. This will serve all the needs of the present, and a complete inventory can be ordered when the city finds that it would be desirable.

The investment and operating cost for telephone service may be divided into two principal parts: (1) a part which may be assumed to be independent of the amount of use of the telephones and is fixed for any class of service in substantial accordance with the apparatus required to give the type of service for that class, and (2) the remaining part dependent almost directly on the amount of use of the telephones; that is, on the extent of the telephone traffic. Illustrative examples indicating the necessity of this subdivision are given in the report. The phrase "Readiness to Serve" is adopted in the report to indicate the first part, and the phrase "Service Rendered" to indicate the second part. The setting apart of these two parts of plant from each other is difficult because of the lack of adequate means for keeping separate records of messages belonging to each class of service. The company maintains a count of the messages from all of those subscribers whose bills are based on messages, and it therefore keeps data from which a record may be made of the messages originated by each coin-box class of service and by each of the regular measured-rate classes (omitting the commuted rate lines). It also makes a monthly count (called a "peg count") of all calls for one day in the month, but this gives no information as to the relative number of messages originated by the various flat-rate classes of service of the commuted lines.

The importance of obtaining a true record of the messages originated in each of the latter classes of service will be understood when it is known that much the greater part of the traffic handled by the company's central office comes from the flat-rate and commuted-rate lines. The results of a recent peg count

taken at central offices serving the business part of the city show that 17,011 lines in these classes originated no less than 632,796 calls during 24 hours, while the 36,668 measured-rate lines of the same central offices originated only 400,356 calls during the same 24 hours. Similar results are exhibited by the records of all the monthly peg counts.

As already indicated, a large part of the cost of giving service is proportional to the amount of the traffic, and it is an essential feature of the plan presented in the report that the records of traffic shall be complete. The great disparity in the traffic of the different classes must make a large difference in the cost of service, and the conditions relating to the cost in the different classes cannot be adequately known until arrangements have been devised for keeping classified records of the messages originated by the flat-rate and commuted-rate subscribers, as well as the others. The most satisfactory way of doing this is by putting a message register or meter on every flat-rate and commuted-rate line; but, owing to the fact that message registers are not yet installed, the company should organize a special force of clerks for counting and supervising the counting of these messages until registers are installed. The report points out that the company is now taking steps to organize such a force.

It is obvious that over 170,000 telephones cannot be considered individually, one by one, on account of the insuperable difficulty and cost of keeping records, but that they must be considered in groups of similar character. These groups are fixed by the schedule of rates imposed on the company by the ordinance. The service to meet each subscriber's needs most economically can be obtained by him from some one of the classes of service of the rate schedule, and subscribers of reasonably similar requirements are therefore attracted together in groups corresponding to the rate classes. The rates are so numerous and carefully adjusted that every user can get telephone service adapted to his needs. It is therefore convenient and proper to adapt the accounting methods so as to arrive at the average cost of service for each of these classes. In pursuance of this object the report shows a plan for apportioning the company's investment among the same classes, and segregating the revenue according to the classes.

Reports of New York Public Service Commissions for 1908.

Reports for the year ended Dec. 31, 1908, have been made to the New York State Legislature by the Public Service Commissions of the First and Second Districts.

REPORT OF THE FIRST DISTRICT COMMISSION.

A brief summary of the report of the commission of the First District, which has been published in advance of the publication of the full report of three volumes, shows that the surface, elevated and subway companies in New York City carry annually over 1,300,000,000 passengers, which is over 66 per cent more than the total number of passengers carried on the steam railroads of the entire country. These companies have a capitalization of over $533,000,000, and derive annually from their passengers over $62,000,000. The gas and electric companies have a capitalization of over $386,000,000, and the amount of gas sold annually is over 32,000,000,000 cu. ft., which is more than 20 per cent of the entire gas production in the United States. The income from the sale of electricity in New York City is over $20,000,000.

The commission refers to the reports of Mr. Bion J. Arnold, who was retained as special engineer to make an investigation of the subway as operated. Following the recommendations of Mr. Arnold the commission has requested the Interborough Rapid Transit Company to equip two experimental trains with side doors, and to install a system of speed control on the express tracks.

In addition to over 3000 complaints as to service rendered by transportation companies, the commission has received about 9000 complaints affecting gas and electrical corporations, chiefly as to the accuracy of meters. Nearly all of the complaints regarding gas and electrical corporations have been adjusted without formal hearing. In each of the few instances where an informal hearing before one of the commissioners has been required, the companies have accepted the findings and given the relief suggested.

Regarding the forms of accounts and reports, the commission says it found that little work had been done on behalf of electric railroads and gas and electric companies "other than by certain technical associations, whose systems were not compulsory, nor had they been generally accepted because of considerable differences of opinion within the associations themselves."

The problems which have arisen with gas and electric companies during the year have related principally to the instruments for measuring the service and to the conditions that the companies have sought to improve in their contracts for service. The report adds:

"The various types of electric meters in use in the city are being tested and examined to determine whether there are any that ought not to be used because of defects in principle or nature of construction.

"One of the conditions imposed by the companies when the electric inquiry was begun provided that a consumer could take electricity from no other source even including in the prohibition his own lighting plant. This condition was gradually driving out of use the private plants in the large buildings, for the owners could not run the risk of their own plants breaking down and be without the ability to get electricity from the company. The commission has brought about an agreement upon the part of the companies to give 'break-down' and 'auxiliary' service to owners of private plants."

REPORT OF THE SECOND DISTRICT COMMISSION.

The report of the Second District Commission states that at the close of the calendar year 1908 there were 854 corporations, municipalities and individuals engaged in serving the public in some capacity that by operation of law placed them under the supervision of the commission. Of this number 313 comprised electrical corporations and plants, divided as follows: Operating, 183; not operating, either inchoate or dormant, 17; not operating, lessor, 5; individuals operating plants, 60; municipalities operating plants, 48. There were 141 street railroad corporations, 48 coal-gas or water-gas and electrical corporations and 4 electrical and natural gas corporations.

Various fundamental decisions respecting capitalization are discussed in the report. It was held by the commission that the use of capital to be secured by the issue of stock, bonds or other evidence of debt must be necessary for one or more of the purposes specified in sections 55 and 69; that an enumeration of purposes for which stock, bonds and other evidences of debt may be issued is exclusive and not inclusive; that the stock and bonds may not be issued for purposes not enumerated in the statute, either with or without the authority of the commission. It was held that a scrip dividend, in the case of the Erie Railroad, is not one of such purposes; that a stock dividend, in the case of the Babylon Electric Light Company, is not one; and that the reimbursement of a treasury for previous payments made for one of the purposes named in the statute, in the case of the Lehigh & Hudson River Railway, is not one. It was pointed out that no capital would be secured to the company by the proposed issue of stock or scrip and that money secured by bond issues for the reimbursement of the treasury could be expended for any lawful purpose, although not a purpose named in sections 55 and 69 of the law.

An abstract of other decisions affecting capitalization follows:

"In the application of the Newburgh Light, Heat & Power Company the commission denied the application for authorization of preferred stock to the amount of $250,000, holding that the condition of the money market, taken in connection with the physical condition of the applicant corporation, did not justify a fixed charge of this amount.

"In the application of the Watertown Light & Power Company for authorization of an increase of its capital stock and bonded indebtedness, the commission adopted, unanimously,

certain propositions, as follows: (*a*) That it will not investigate or inquire into the correctness of the capitalization of the Watertown Light & Power Company authorized by the former Commission of Gas and Electricity; and therefore will not inquire in this proceeding into any alleged over-capitalization of the applicant existing at the time the application was made; (*b*) that the investigation upon this application for additional capitalization will be confined to the question whether such capitalization should be authorized by reason of the actual investment of the money to be secured thereby for purposes of the corporation recognized by law as a subject of capitalization.

"An interesting question early presented itself as to what extent the investing public might be justified in relying upon the authorization given by the commission as an implied certificate that the bonds or stock to be issued were worth their face value or any other amount. This question arose upon the application of the Hudson River Electric Power Company for leave to issue $3,232,000 bonds. The commission said: 'In passing upon the application for leave to issue additional capital stock, the commission will consider: (5) Whether there is reasonable prospect of fair return upon the investment proposed, to the end that securities having apparent worth but actually little or no value may not be issued with our sanction. We think that to a reasonable extent the interests of the investing public should be considered by us in passing upon these applications. The commission should satisfy itself that, in a general way, the venture will be likely to prove commercially feasible, but it should not undertake to reach and announce a definite conclusion that the new construction or improvement actually constitutes a safe or attractive basis for investment. Commercial enterprises depend for their success upon so many conditions which cannot be foreseen or reckoned with in advance, that the duty of the commission is discharged as to applications of this character when it has satisfied itself that the contemplated purpose is a fair business proposition.'

"In the case of the Watertown Light & Power Company upon practically the same point the commission held that the purchasers of securities authorized by it are not exempt from the business risks involved in the possibility of the corporation issuing the securities being over-capitalized."

The commission states that "in the three matters of discount on bonds, working capital, and allowance for promotion or services, the practice is understood to be different from that prevailing in Massachusetts. Since 1894, commissions in that State have had control of the amount of securities that public service corporations can issue for any and all purposes. Both the railroad and the gas and electric light commissions refuse to permit securities to be issued for discount on bonds. It is understood that the railroad commission apparently disapproves of an issue of stock or bonds to provide working capital, but that the gas and electric light commission permits this item to be included in a company's original capitalization."

In discussing the policy which it pursues in these matters the New York commission says it "has not found occasion to doubt the correctness of its conclusions upon these points. It has endeavored and will continue to endeavor to make its rulings such as to encourage the investment of capital and the promotion of enterprise. The interests of the public imperatively demand these results, and the commission believes that they are not in the slightest degree inconsistent with the protection of the public against those practices which have justly earned the condemnation of the public and led to the regulation of corporate capitalization by law."

The commission calls especial attention to the fact that in the preparation of uniform systems of accounts it "has kept in constant touch with the corporations themselves, has invited and profited by constant comment and criticism, and has endeavored in every way to make the bookkeeping it prescribes practical as well as theoretically correct."

Mr. William J. Meyers, statistician of the commission, is given the credit of the "technical excellence and perfection of form" of the accounts.

The commission makes the following statement in reference to the schemes of accounts adopted:

"Uniformity has been sought for wherever it seemed to be practicable to obtain it. It has been recognized, however, that to attempt to secure uniformity of accounting where uniformity of fact does not exist, is to abandon the substance for the form, and there has been no attempt to push uniformity to such lengths as to secure merely specious results.

"The smaller corporations are less highly organized than the larger corporations, and the minuteness of classification of labor which is practicable in the larger is impracticable in the smaller. Furthermore, the managers of the smaller corporations are in more immediate contact with the detailed affairs of the corporation, and for that reason do not need the minuteness of accounting that is imperative in the larger concerns. This condensation has seemed practicable only in the various income accounts. The capital accounts are accounts that continue during the life of the corporation, and it is much more essential that the same scheme of accounts be continued throughout the corporation's entire history. The income accounts are closed annually, and a radical change in them produces little other inconvenience than to prevent comparisons with accounts of prior years. If the change is confined to a further subdivision of those of prior years, not even this inconvenience results. On the other hand, a change in capital accounts involves matters covering a very considerable period of time and the record of which is frequently too incomplete to permit reclassification. Growth is the normal course of affairs for a well-organized, well-managed public service corporation in a healthy and thriving community, and this fact, coupled with the well-founded conviction that there is necessarily a much more accurate accounting for capital than has prevailed in the past, has led to the provision of a single scheme of capital accounts for corporations of all grades in a particular class.

"The matter of reports to be required of public service corporations is intimately connected with that of the system of accounts to be kept by such corporations. The scheme of accounts and the scheme of reports are very closely connected, and the annual reports cannot be brought to show the situation fully and clearly until the scheme of accounts on which they depend has been brought into satisfactory form. An annual report of a corporation ought to furnish such information as should be filed regularly, not only for the information of the commission intrusted with the administration of such a law as the Public Service Commissions Law, but also for that of the investors furnishing the capital essential to the operations of the corporations, and for that of the much larger body of consumers for the satisfaction of whose needs the corporation exists and from whom are derived the revenues by which the corporation is supported. Much of this information is not given when the report is confined to a summary statement of receipts and expenditures. It is also necessary to know who are the individuals whose identity is frequently hidden behind the legal entity or fiction of the corporation; cases have occurred in times past where by hiding behind various corporate cloaks, individuals have been able to enrich themselves without rendering a fair return for the revenues collected from the public. The construction company and the supply company are familiar instances of such devices. For this reason it has been thought advisable, in the annual reports required of corporations, to go somewhat fully into the matter of intercorporate relationships.

"Another thing that has not needed to wait for a more complete establishment of a uniform system of accounts is the matter of new capital installed in service and old capital withdrawn from service."

Of the 1147 informal correspondence cases handled during the year, 40 related to the rates and service of electrical corporations, and of that number 31 have been closed.

One section of the report is devoted to the work of the division of light, heat and power. An abstract of the part of this section relating to electrical work follows:

"Section 67 of the Public Service Commissions Law provides that no corporation or person shall furnish or put in use any electric meter which shall not have been inspected, approved, stamped, or marked by an inspector of the commission. Con-

ferences were had in 1907 with representatives of the electrical corporations under the supervision of the commission, and with meter manufacturers and experts, and after painstaking inquiry into all the problems presented, the conclusion was reached that a literal administration of the provision in question would be commercially impracticable and futile in results. We would again call attention to the fact that the accuracy of registration of electric meters is affected by many more conditions than apply to the accuracy of gas meters, to which a similar provision of the law refers. While this does not imply that the electric meter is less accurate as a measuring device than the gas meter, the fact emphasizes the necessity of meeting in some manner the inspection of these meters within the intent of the law. The attention of the commission has therefore been engaged in devising and putting in operation a system of inspecting consumers' electric meters, which would in effect answer the requirements of the law, and the administration of which would not impose a prohibitive expense upon the State. This system calls for tests made by the companies with standard instruments approved as to type, and periodically checked for accuracy, by the commission.

"Section 67 of the Public Service Commissions Law provides that every electrical corporation shall provide or keep in and upon its premises a suitable and proper apparatus, to be approved, stamped, or marked by the commission, for testing and proving the accuracy of electric meters furnished for use by it.

"Thirty-four of the plants of 325 electrical corporations were found not selling electric energy on a meter basis, and were therefore not required to obtain standards. Of 291 electrical corporations operating electric meters, 218 were found either with no standards, or insufficiently equipped with standards. Recommendations were made to each of these companies, based upon the inspectors' reports, indicating the type of instrument best adapted to the need of each company, and resulting in 167 companies equipping themselves with satisfactory standards; 51 plants operating on a limited scale filed objections to incurring the expense. Consideration was of necessity given to such objections, and where upon investigation the commission was of the opinion the objections were well founded, compliance with the recommendation was for the time being waived. Fourteen other companies, unable for the present to finance the purchase of standards, entered into arrangement, with the approval of the commission, for the use of the instruments of companies operating in adjacent territories.

"A comparatively large number of the companies having reported by June 23, 1908, the installation of the apparatus recommended by the commission, a resolution was adopted providing that each electrical corporation provided with apparatus for testing the accuracy of electric meters furnished to its consumers report to the commission the customers' meters tested each month with such apparatus, beginning with August, 1908.

"The resolution of the commission and the rules and regulations prepared pursuant thereto go further than requiring a report of all new meters tested. Every test, whether initial, upon complaint or periodic, and the results shown, must be given. The next step under consideration is to require, if necessary, an initial test of all meters when furnished to consumers, and possibly also to require the systematic inspection of meters in use. The necessity of such an order will be determined upon consideration, among other things, of the character of the reports filed by the companies.

"The standards used by the companies in making these tests of consumers' meters are periodically checked by the commission's inspectors against portable standard instruments, these portables in turn being calibrated not less than once a month by comparison with the commission's laboratory standards in Albany.

"During the year inspections were made of 1812 standards belonging to 204 companies. Ten and one-half per cent of these standards were found inaccurate and ordered re-calibrated, and approximately 1 per cent of the total were disapproved as to type.

"During the year complaints were filed by consumers against 85 electric meters. The results of tests show 20 of the 85 meters to have been found defective or incorrect to the prejudice of the consumer, in that they registered 4 per cent or more fast on one or more of the load points at which tested. These incorrect meters were either replaced immediately with correct meters, or were calibrated to register within the limits of error allowed by law.

"Special investigations were made into the affairs of a number of companies for the purpose of ascertaining the methods employed by them in the transaction of their business, and in the maintenance and operation of their plants and distributing systems.

"Many disputes of a minor nature arising between individual consumers and companies, have been brought to the attention of the commission for settlement, generally at the instance of the consumer as complainant. The legal right of gas and electrical corporations to make a minimum charge for the supply of gas or electricity is the subject of many of these inquiries. Upon the advice of counsel, the commission in answering these inquiries has taken the position that unless forbidden in a local act governing in a particular municipality, a reasonable minimum charge may be made. What is a reasonable charge is a matter for determination after investigation of all the conditions under which the charge is made."

Rates and Franchise Valuation Discussed in Consolidated Gas Decision.

The memorandum of the decision of the United States Supreme Court in the case of the Consolidated Gas Company, of New York, and the 80-cent gas laws was published in the issue of Jan. 7, page 96. The full decision of the court, which was given out on Jan. 11, amplifies the summary contained in the memorandum in many important respects.

The court states that "the question arising is as to the validity of the acts limiting the rates for gas to the prices therein stated. The rates must be plainly unreasonable to the extent that their enforcement would be equivalent to the taking of property for public use without such compensation as under the circumstances is just both to the owner and the public. There must be a fair return upon the reasonable value of the property at the time it is being used for the public."

It is held that the case "must be a clear one before the courts ought to be asked to interfere with State legislation upon the subject of rates, especially before there has been any actual experience of the practical result of such rates. . . . In order to determine the rate of return upon the reasonable value of the property at the time it is being used for the public, it of course becomes necessary to ascertain what that value is."

The court then takes up the question of the value of the property, tangible and intangible. It states that "the value of real estate and plant is to a considerable extent matter of opinion, and the same may be said of personal estate when not based upon the actual cost of material and construction. Deterioration of the value of the plant, mains and pipes is also to some extent based upon opinion."

All these matters make questions of value, the court thinks, somewhat uncertain; while added to this is an alleged prospective loss of income from a reduced rate, depending upon the extent of the reduction and the probable increased consumption, constituting "a problem as to the character of a rate which is difficult to answer without a practical test from operation of the rate."

Respecting the action of a lower court in enjoining the enforcement of a rate that is confiscatory beyond doubt, the decision says: "There may be cases where the rate is so low, upon any reasonable basis of valuation, that there can be no just doubt as to its confiscatory nature, and in that event there should be no hesitation in so deciding and in enjoining its enforcement without waiting for the damage which must inevitably accompany the operation of the business under the objectionable rate.

"But where the rate complained of shows in any event a very narrow line of division between possible confiscation and proper regulation, as based upon the value of the property, found by the court below, and the division depends upon opinions as to value, which differ considerably among the witnesses and also upon the results in the future of operating under the rate objected to, so that the material fact of value is left in much doubt, a court of equity ought not to interfere by injunction before a fair trial has been made of continuing the business under that rate, and thus eliminating, as far as possible, the doubt arising from opinions as opposed to facts."

In giving the history of the company, the court indicates that the companies whose property was acquired by the Consolidated Gas Company were not called upon to pay anything for their franchises. In the consolidation the value of the franchises was set at $7,781,000. The court says it "cannot be disputed that franchises of this nature are property and cannot be taken and used by others without compensation. The important question is always one of value." The lower court had held that a fair method of fixing value of franchises in 1905 was to "assume the same growth in value for the franchise as is demonstrated by the evidence in the case of tangible property." Based on the increased value of personalty and realty, the lower court, therefore, thought the franchise valuation had appreciated to over $12,000,000.

The Supreme Court states that it is "not prepared to hold with the court below as to the increased value which it attributes to the franchises. It is not only too much a matter of pure speculation, but we think it is also opposed to the principle upon which such valuation should be made."

The rates of the company are subject to regulation by the Legislature, provided they are not made so low as to be confiscatory. From the creation of the companies to their consolidation in 1884, the companies had been free from legislative regulation upon their rates. The companies had been most prosperous and had divided large earnings. So far as the evidence presented before the Senate committee appointed in 1885 to investigate the consolidation showed there was nothing on Nov. 10, 1884, to indicate that the franchises would not be as valuable in the next 20 years as they had been in the past. The price charged by the various companies "may have been too high, and the dividends were excessive, but they were not illegal, and the valuation of the franchises computed upon these dividends and that state of facts cannot be called a violation of the law that expressly authorized it to be done, unless such valuation was too high."

The Supreme Court concludes, concerning the value of the franchises, that "although the State ought, for these reasons, to be bound to recognize the value agreed upon in 1884 as part of the property upon which a reseasonable return can be demanded, we do not think an increase in that valuation ought to be allowed upon the theory suggested by the court below."

The increase in consumption of gas and in the value of tangible property of the corporation is not regarded by the court as any reason for attributing a like proportional increase in the value of the franchise. The moment immunity from legislative interference with the price of gas ceased "the great value of the franchise would be at once and unfavorably affected, but how much so it is not possible for us now to see. The value would most certainly not increase."

The lower court "found the value of the tangible assets actually employed at the time of the commencement of this suit in the business of supplying gas by the complainant to be $47,831,435, to which it added the $12,000,000 as the value of the franchises as found by it, making the total of $59,831,435, upon which it held that the company was entitled to a return of 6 per cent, being $3,589,886.10. It also found its total net income for the year 1905 amounted to $5,881,192.45, almost 10 per cent upon the sum above named. Altering the finding of the court so far only as to place the value of the franchises at the time agreed upon in 1884, $7,781,000, the total value upon that basis of the property employed by the company would be $55,612,435, upon which 6 per cent would be $3,336,746.10, while the sum estimated as the return on 80-cent gas would have been $3,024,592.14, which is nearly 5.5 per cent on the above total of $55,612,435."

Limiting its conclusions concerning franchise value to the case before it, the Supreme Court says:

"What has been said herein regarding the value of the franchises in this case has been necessarily founded upon its own peculiar facts, and the decision thereon can form no precedent in regard to the valuation of franchises generally, where the facts are not similar to those in the case before us.

"There is no particular rate of compensation which must in all cases and in all parts of the country be regarded as sufficient for capital invested in business enterprises. Such compensation must depend greatly upon circumstances and locality; among other things, the amount of risk in the business is a most important factor, as well as the locality where the business is conducted and the rate expected and usually realized there upon investments of a somewhat similar nature with regard to the risk attending them. There may be other matters which in some cases might also be properly taken into account in determining the rate which an investor might properly expect or hope to receive and which he would be entitled to without legislative interference. The less risk, the less right to any unusual returns upon the investments.

"One who invests his money in a business of a somewhat hazardous character is very properly held to have the right to a larger return without legislative interference than can be obtained from an investment in government bonds or other perfectly safe security. The man that invested in gas stock in 1823 had a right to look for and obtain, if possible, a much greater rate upon his investment than he who invested in such property in the City of New York years after the risk and danger involved had been almost entirely eliminated.

"In an investment in a gas company, such as complainant's, the risk is reduced almost to a minimum. It is a corporation, which in fact, as the court below remarks, monopolizes the gas service of the largest city in America, and is secure against competition under the circumstances in which it is placed, because it is a proposition almost unthinkable that the City of New York would, for purposes of making competition, permit the streets of the city to be again torn up in order to allow the mains of another company to be laid all through them to supply gas which the present company can adequately supply.

"And so far as it is given us to look into the future, it seems as certain as anything of such a nature can be, that the demand for gas will increase, and, at the reduced price, increase to a considerable extent. An interest in such a business is as near a safe and secure investment as can be imagined with regard to any private manufacturing business, although it is recognized at the same time that there is a possible element of risk, even in such a business. The court below regarded it as the most favorably situated gas business in America, and added that all gas business is inherently subject to many of the vicissitudes of manufacturing. Under the circumstances, the court held that a rate which would permit a return of 6 per cent would be enough to avoid the charge of confiscation, and for the reason that a return of such an amount was the return ordinarily sought and obtained on investments of that degree of safety in the city of New York."

The Supreme Court therefore concurs with the lower court in the opinion that the company is entitled to 6 per cent on the fair value of its property devoted to the public use. The total value is considered, however, a "matter of speculation or conjecture to a great extent."

In stating that a test is necessary to demonstrate the reasonableness or unreasonableness of a rate, the court says: "There may be cases where the evidence as to the probable result of the rates in controversy would show they were so nearly adequate that nothing but a practical test could satisfy the doubt as to their sufficiency.

"The elevated railroads in New York when first built charged 10 cents for each passenger, but when the rate was reduced to 5 cents it is common knowledge that their receipts were not cut

in two, but that from increased patronage the earnings increased from year to year and soon surpassed the highest sum ever received upon the 10-cent rate.

"There is always a point below which a rate could not be reduced and at the same time permit the proper return on the value of the property, but it is equally true that a reduction in rates will not always reduce the net earnings, but, on the contrary, may increase them. The question of how much an increased consumption under a less rate will increase the earnings of complainant, if at all, at a cost not proportioned to the former cost, can be answered only by a practical test. In such a case as this, where the other data upon which the computation of the rate of return must be based are from the evidence so uncertain, and where the margin between possible confiscation and valid regulation is so narrow we cannot say there is no fair or just doubt about the truth of the allegation that the rates are insufficient."

The court also takes up the contention of the corporation that the State, having taxed it upon its franchises, cannot be heard now to deny their existence or their value as taxed. The court holds that "the fact that the State has taxed the company upon its franchises at a greater value than is awarded them here, is not material. These taxes, even if founded upon an erroneous valuation, were properly treated by the company as part of its operating expenses, to be paid out of its earnings before the net amount could be arrived at applicable to dividends, and if such latter sums were not sufficient to permit the proper return on the property used by the company for the public, then the rate would be inadequate. The future assessment of the value of the franchises, it is presumed, will be much lessened if it is seen that the great profits upon which that value was based are largely reduced by legislative action."

The court is also of the opinion that it is not a case for a valuation of good-will. In concluding, the court states: "Upon a careful consideration of the case before us we are of opinion that the complainant has failed to sustain the burden cast upon it of showing beyond any just or fair doubt that the acts of the Legislature of the State of New York are in fact confiscatory. It may possibly be, however, that a practical experience of the effect of the acts by actual operation under them might prevent the complainant from obtaining a fair return, as already described, and in that event complainant ought to have the opportunity of again presenting its case to the court. To that end we reverse the decree, with directions to dismiss the bill without prejudice."

Program for Minnesota Electrical Association

The Minnesota Electrical Association, which held its first meeting last February, will hold its second convention at the Nicollet Hotel, Minneapolis, March 18 and 19, 1909, for which the following program of papers has been announced:

"Proper Method of Purchasing and Using Coal," by Mr. Ludwig Kemper, Albert Lea, Minn. "Use of Tungsten Lamps from the Illuminating Engineer's Point of View," by Mr. J. R. Cravath, Chicago, Ill. "Use of Tungsten Lamps for Street Lighting, Particularly in Connection with a Decorative Scheme of Lighting," by Mr. H. J. Gille, Minneapolis, Minn. "Methods of Building Up a Day Load in Small Central Stations," by Mr. A. Wagner, New Ulm, Minn. "Heating Appliances as an Aid in Developing a Day Load," by Mr. E. L. Callahan, Chicago, Ill.

Other features will be a paper by Professor George D. Shepardson, of the University of Minnesota, subject to be announced later; report of the committee on fire insurance; address on taxation of public service corporations, by a member of the Minnesota Tax Commission; a complimentary dinner the evening of March 18, and a theater party. The latter two entertainment features are tendered by the electrical manufacturers, jobbers and supply dealers of the Twin Cities. The program is in the hands of the executive committee, Mr. W. R. Putnam, of Red Wing, Minn., being president. The secretary is Mr. Ludwig Kemper, of Albert Lea, Minn.

Lighting Chicago Railroad Under-Crossings.

Owing to the elevation of railroad tracks in Chicago, there are in that city 468 under-crossings at intersecting streets. About half of these are now lighted, and the city has started a movement to compel the railroads to illuminate all passages adequately, the claim being made that the under-crossing spaces are favorite lurking places of the vicious bent upon crime. Recent ordinances relating to track elevation provide for subway lighting; the railroads do not question their obligation in regard to these, but claim that they are not responsible for lighting when previous ordinances did not contain any requirement to that effect. According to statistics, of the 468 railroad subways, only 75 are properly lighted, 166 are partially lighted and 227 are not lighted. Eight hundred and seventeen additional arc lights will be needed to light all the passages properly, and the city law department will take measures against the railroads to assure such proper illumination.

Work of State Railway Commissioners.

Committees of the National Association of Railway Commissioners have been appointed by President Martin S. Decker, who has issued a circular discussing the work confronting the various committees before they report to the twenty-first annual convention, to be held at Washington, D. C., on Oct. 12, 1909. Mr. Decker recommends that the committee on "Powers, Duties and Work of State Railway Commissions" make a "voluminous report showing all of the State laws pertaining to regulations, with a table or diagram accompanying the report, and the text to further include a statement, as complete as practicable, of the work in different States. It would seem that the appropriate body to publish an up-to-date statement and account of State laws and State work as to railway regulation and other regulation of public service corporations is the National Association of Railway Commissioners, because it possesses all necessary facilities. Most of the work of the association has related in the past to steam railroads, but it has a committee to consider the system of accounts for electric railways.

New England Section of the N. E. L. A.

An important step in central-station organization has just been taken in connection with the work to affiliate State bodies with the National Electric Light Association. About 80 members of the association in the New England States have made application and received permission from the executive committee to organize a special geographical section. The Boston Edison Company gave these members a dinner at the Algonquin Club, Boston, Dec. 30, at which Mr. Charles L. Edgar, president of the company, was the generous and felicitous host. After the dinner an organization meeting was held.

Mr. W. C. L. Eglin, president of the National Electric Light Association, made a very able and interesting address describing the great work of the association and its growth and development from the date of its organization, February, 1885, down to the present time, calling attention to the wonderful amount of good it has accomplished during all those years and the great work it will have to do in the years to come. Speeches were also made by Messrs. W. W. Freeman, E. W. Burdett, R. M. Searle, G. R. Stetson, J. S. Whitaker, H. T. Sands, E. E. Larrabee, J. E. Davidson and John Campbell.

A nominating committee was appointed by Mr. Edgar, on motion of the delegates, consisting of Mr. Fred P. Royce, Mr. E. E. Larrabee and Mr. John Campbell, and brought in a list of officers to be balloted for, who were unanimously elected. They are as follows: S. Fred Smith, president, Salem, Mass.; J. E. Davison, vice-president, Montpelier, Vt.; Chas. H. Hodskinson, secretary and treasurer, Boston, Mass. Executive committee: J. A. Fleet, Portland, Me.; J. S. Whitaker, Portsmouth, N. H.; H. T. Sands, Haverhill, Mass.; A. B. Lisle, Providence, R. I.; Alex. Campbell, New London, Conn.

Meeting of Society of Wireless Telegraph Engineers.

At a meeting of the Society of Wireless Telegraph Engineers held at 192 Bay State Road, Boston, Mass., Jan. 4, Dr. R. T. Wells delivered an address on the subject of "The Inductance, Resistance and Impedance of Telephones as a Function of the Frequency of the Current Actuating Them." Mr. Sewall Cabot spoke upon the power rating of wireless telegraph stations, and Mr. John Stone Stone spoke on the audibility of wireless telegraph signals in their relation to the spark frequency at the transmitting station. He gave the results of a mathematical inquiry which indicates that the audibility of wireless telegraph signals is more a function of the harmonics than of the fundamental of the wave-train frequency.

The next meeting of the society will be held on Feb. 1, when Mr. C. E. Russell will present a paper on the subject of a "New Magnetic Detector," and Mr. E. D. Forbes another on "The Singing Arc."

Annual Banquet of Massachusetts Technology Alumni.

The annual banquet of the Technology Alumni Association was held in Horticultural Hall, Boston, on Jan. 14. The speakers were Governor Eben S. Draper, of Massachusetts, class of '78; Acting-President Arthur A. Noyes, of the Institute, class of '86; President-elect Richard C. Maclaurin; and Dr. Robert S. Woodward, of the Carnegie Institute of Washington. Dr. Maclaurin voiced the need of removal of the institute to a new site, in order to enable its development to continue, and anticipates the practical report of the Commonwealth of Massachusetts in this undertaking. Governor Draper spoke encouragingly of the Institute's problems under the forthcoming administration of President Maclaurin, and Dr. Noyes outlined the recent work of the institution. Dr. Woodward urged the co-operation of all attached to the institute in its future activities. Mr. Edwin S. Webster, class of '88, and a member of the firm of Stone & Webster, Boston, was elected president of the Alumni Association for the ensuing year.

Miller on Development of Telephone Industry.

Mr. Kempster B. Miller, consulting telephone engineer, addressed the noonday meeting of the Chicago Electric Club Jan. 13 on "The Development of the Telephone Industry." He took as a specific example of the general development that in Chicago. The Chicago Telephone Company now has, roughly, 180,000 telephones connected, this being the second largest telephone exchange in the world. The growth last year amounted to 35,000 instruments, which was equal to the entire growth of the first 23 years of the company's existence. Within a radius of 20 miles of New York City there are more telephones than in the entire British Isles. Chicago has the busiest telephone exchange in the world, if the number of calls per subscriber is taken as a measure, the average being 22 calls per line per day. There are 35 exchange buildings. The underground conduit amounts to 435 miles, there are 377,000 miles of underground wire, and the overhead wire foots up to 65,000 miles. The company employs about 5600 operators.

Mr. Miller said that the automatic exchange system had proved to be a success by demonstration in a number of large exchanges, and that it is being installed in other very large exchanges. There is a compromise between the purely automatic and the manual systems, called the semi-automatic. On this system the numbers are given orally to a telephone operator, who is provided with certain automatic apparatus for making the connection to complete the call. Mr. Miller seemed to think it inevitable that the manual system would be superseded either by the automatic or semi-automatic systems.

He spoke briefly on the telegraph situation. Both the Western Union and the Postal companies have machine transmission on certain New York and Chicago lines. These systems are not strictly high-speed, being of the same order of speed as a wire worked quadruplex. He thought, however, that some high-speed system would come into use, in which thousands rather than hundreds of words per minute would be transmitted.

Defense of Cable Rates.

At a meeting of the New York City Board of Trade and Transportation in December, the committee on foreign and insular trade was instructed to make an investigation as to whether or not cable tolls could not be reduced. In response to this inquiry Mr. George C. Ward, vice-president and general manager of the Commercial Cable Company, has sent to the committee a defense of the present rates. After entering a general denial that there is any combination or agreement between the cable companies, he says: "The statement that 25 cents per word is a high rate and that it discourages trade is not in accord with the facts as ascertained by experience. A number of years ago the Atlantic cable rate was reduced to 12 cents per word, and that low rate continued for two years and four months. This thorough and costly test proved that the reduction of the rate to such a very low figure produced only a 16 per cent increase in the volume of traffic, while the receipts were diminished by nearly one-half in cash. The cable business was done at a loss. The restoration of the rates to 25 cents per word was a necessity. Moreover, less than 1 per cent of the public use the cables, and a reduction of cable rates would merely mean increased profits to that 1 per cent to the ruin of the cable companies.

"Owing to the complaints that the restriction to genuine words did not give merchants a sufficient range of words to make up efficient codes the cable companies have gradually relaxed their rules and have admitted artificial or manufactured words, which are supposed to have some semblance to real words. It is almost impossible to transmit by cable such words rapidly and correctly, and yet any change or omission of even one letter would make an entirely different meaning. To transmit artificial codewords by cable is most difficult. To transmit them with speed is impossible. When it is borne in mind that 98 per cent of the cable messages are in cipher code and each code word represents at least 20 plain words, it will be seen that cablegrams in code bring the rate down to less than 2 cents a word for the translated message."

Boiler Corrosion from Electrochemical Causes.

Professor C. F. Burgess, of the University of Wisconsin, read a paper before the electrical section of the Western Society of Engineers at Chicago, Jan. 15, on "Boiler Corrosion from Electrochemical Causes." He supported the theory that most kinds of corrosion of iron and steel could be accounted for by electrolysis, and presented some slides and evidence to show that a galvanic couple necessary to produce electrochemical action may be produced in one of three ways, giving examples of each kind. One kind of electrolytic action he classed as being caused by differences in temperature between different parts of the metal structure, this difference in temperature causing a difference in potential sufficient to produce galvanic action. Another class of corrosion he classified as caused by differences in composition of various parts of the steel structure. This would cause galvanic action between such different parts. The third kind he classified as due to a difference in mechanical treatment of different parts of the structure. Steel which is pressed or punched in a manner to make it harder or more dense than the surrounding structure will show a difference of potential with reference to the surrounding structure if an electrolyte is present.

Fort Wayne, A. I. E. E., Meeting.

The fifth regular meeting of the Fort Wayne Section of the American Institute of Electrical Engineers was held on Thursday evening, Jan. 14, in the rooms of the Fort Wayne Engineering & Manufacturing Company. The chair was occupied by the vice-chairman, Mr. J. J. Kline. The paper of the evening was presented by Mr. L. D. Nordstrum entitled "Some Considerations Involved in the Design of Direct-Current Generators and Motors." Mr. Nordstrum took up this question at first from the technical features involved in the design of a new line of electrical machines or the redesign of an old line. The watts lost in the machine and the effect of the heat on the insulation were then considered, followed by comparisons of the weights of copper and iron in the machine and the consideration of the cost for varying quantities of each. He presented curves showing the effect of the increase of copper and the increase of iron on the cost of the machine and the conditions necessary to build a machine, first, with the least cost and also the least weight. Those taking part in the discussion which followed were Messrs. J. J. Kline, E. A. Barnes, J. V. Hunter, A. L. Hadley and J. H. Haberly.

Street Lighting.

The meeting of the New York Section of the Illuminating Enginering Society, held on Jan. 14, was devoted to the presentation and discussion of two papers dealing with street lighting. A paper by Mr. Walter C. Allen discussed briefly a few features of European practice and treated quite freely the local conditions in the District of Columbia. Descriptions were given of the lighting equipment of the plaza in front of the new Union Station, where magnetite arc lamps and tungsten lamps are used, and the Connecticut Avenue bridge, where Nernst lamps are employed. A valuable feature of the paper is the report of illumination surveys made by the Electrical Testing Laboratories of New York along certain streets in Washington. The tests showed the following typical results:

Kind of lamp.	Cost per foot of street, cents.	Average illumination, foot-candles.	Average variation from mean, per cent.
Magnetite arc	27.5	0.062	106.9
Series enclosed arc (d. c.)	27.5	0.036	106.9
Graphitized carbon incandescent.	25.2	0.012	29.6
Tungsten series	25.2	0.013	33.0
Mantle gas	32.1	0.028	24.8

The value for the cost is that for the lighting per foot of street in each case.

Mr. S. G. Rhodes presented a paper entitled "Street Lighting by Tungsten Lamps," which described series tungsten lighting systems used in Riverside, St. Nicholas and High Bridge Parks and along Riverside Drive in New York City. The energy is distributed by way of underground cables of the lead-armored or steel-armored type. The lead-covered cables were laid in fiber ducts, while the steel-covered cable was dropped directly into ditch.

DISCUSSION.

In reply to a question by Mr. H. Thurston Owens, Mr. Allen stated that the street lamps are used 3960 hours per year. Each arc lamp costs $85 per year; a 25-cp carbon-filament lamp, $20; a 40-cp tungsten lamp, $24; a 60-cp mantle gas lamp, $20.85; a 4-glower Nernst lamp, $65. These prices cover all items, including the equipment and the service.

Mr. L. B. Marks stated that in street lighting with tungsten lamps it is essential to shade the filament in order to decrease the visible intrinsic brightness. The mere fact that one street receives more light than another does not insure that the former is better lighted than the latter; the intrinsic brightness must also be considered.

Mr. E. L. Elliott remarked that, although little attention has been paid in the past to the intrinsic brilliancy of lighting sources in exterior illumination, a change is to be noted at present and this feature is now coming to the front. The tungsten lamp is far too bright to be exposed to direct view.

The retiring secretary of the section, Mr. P. S. Millar, announced that at the next meeting a paper will be presented by Messrs. E. P. Hyde and F. E. Cady, entitled "Selective Emissivity of Incandescent Lamps as Determined by New Photometric Methods." The following men were elected officers of the New York section:

Mr. E. L. Elliott, chairman; Messrs. J. J. Humphreys and C. A. Littlefield, managers; Mr. A. J. Marshall, secretary.

Influence of Cheap Electricity on Electrochemical Industries.

A paper presented at the December meeting of the Faraday Society (London) by Mr. E. A. Ashcroft had for title "The Influence of Cheap Electricity on Electrolytic and Electrothermal Industries." It was pointed out that the extent of future developments of electrochemical industries will depend on the limits to which the cost of electric energy can be reduced at suitable sites. In most cases an industry only becomes economically possible when the price of power has been reduced below a certain point, which varies more or less for every electrochemical industry. The author discusses, in particular, the lowest possible limits of cost for the production of electricity from water power, with special reference to conditions such as exist to-day in Norway. Some industries (the smelting of iron, the manufacture of lime nitrogen, and the complete treatment of complex sulphide ores may be instanced), to be worked commercially, will require a supply of energy at a cost of about $10 per kw-year, and this "low-grade limit" in the opinion of the author can only be obtained from what he calls water powers of Class I—namely, those in which natural conditions enable the development and regulation of power at a very low expenditure of capital—of the order $35 per horse-power capacity, including all necessaries up to the dynamo terminals. The author estimates the corresponding figure at Niagara to have been not less than $150. The number of powers of Class I are not very numerous, and their natural advantages will to some extent be neutralized by the values placed on the water-rights, but many examples exist, and the author gives full particulars of the cost of developing a concrete case in Norway of 7500-kw capacity. This fall costs $37 to develop and equip, and current can be sold at $12.50 per kw-year. At Meraker 3000 hp has been sold for $8.25, and at Notodden (both in Norway) for $9 per kw-year. The second-best source of energy in bulk to-day is what the author calls waterfalls of Class II—namely, those where a high cost of regulation or development is necessary to bring the water to the place of consumption, and to ensure an even supply all the year round. From these electricity can be sold for about $26 per kw-year, while the corresponding figures for oil engines, gas engines, and steam engines are given by the author as $36, $34 and $41 respectively.

Mr. W. R. Cooper pointed out that the cost of water power was frequently what it would fetch, and that it could not be likely to have a fixed value. The price of water power tended to rise, that from other sources tended to fall; water power should, therefore, be purchased outright by the consumers and not merely leased. Mr. Bertram Blount thought that the author had not done justice to sources of power other than water; the notion that very cheap power was required for all electrochemical industries was erroneous. He referred to the possibilities of electric zinc smelting among the industries requiring cheap power awaiting development. Mr. W. Murray Morrison was also of opinion that steam and gas power could be produced cheaper than stated by the author—the former, in some cases, for $15 per kw-year. The author's Class II water power he considered a bad specimen, and he further criticised in some detail other figures given in the paper. He thought that not enough margin had been left for contingencies. The source of the capital was an important consideration that had not been discussed; on it frequently depended the nature and cost of labor. No two schemes were alike, and every one must be considered on its merits, taking all conditions into consideration.

Mr. L. Gaster pointed out that the Niagara plant had been

designed for a far greater output than had up to the present been reached, and that, therefore, the limit of cost of production of power was far below the figures at present obtaining. He suggested the desirability of manufacturing such products as graphite and carborundum at European power centers. Mr. Charles Weiss drew attention to the conditions under which the water powers in the Bavarian highlands were being developed. Dr. H. Borns referred to some of the disadvantages of many water powers, such as inconstancy of supply. Prof. R. H. Smith also remarked on the ice difficulty, which was of frequent occurrence. He did not think it possible, in the case of water powers, to reach the low figures given by the author, and he took exception to the allowances for depreciation made in the paper. Dr. E. Feilmann suggested that very cheap power-gas schemes might be developed in connection with the peat-fuel industry, and he thought that large-scale experiments were being made in this direction. Mr. E. A. Ashcroft, in reply, said his principal purpose had been to draw attention to the very special kinds of water power that were still available, although rare, and not to contrast the various modes of power production. His figures, to which he adhered, represented a probable average. The ice difficulties referred to do not exist in Norway.

A Library for Electrical Men.

By EDWARD F. STEVENS.

Electrical engineers, practical electricians, students and teachers of the science of electricity—everyone interested in electrical matters—doubtless feel at times the need of having immediate recourse to a library where best and newest technical information and data can be had quickly and without restriction to meet the perplexities that arise in the study and pursuit of their intricate profession.

To provide a center where any man so disposed can freely come and be adequately served is the effort of the Pratt Institute Free Library in Brooklyn in its Applied Science Reference Department. Four years ago Miss I. E. Lord, the librarian, discerning an unsatisfied want, and anticipating a new trend in public library endeavor, furnished the front room on the main floor of the library building with the books and papers of technology as an experiment in a new field; and secured to take charge of the room a man who could give all his time and attention to the question of the selection and the best use of technical literature. "Expert guidance" to the books is considered quite as important as the books themselves, and it is for lack of it that many libraries have failed to meet their opportunity in this important field. The response from the engineering public has been so distinctly favorable that the Applied Science Department is encouraged to pursue its aims with confidence, and is expanding its equipment with the fast increasing claims made upon it. The attendance for the first full year, ending Aug. 31, 1905, was 8767; for the year ending Aug. 31, 1908, it was 17,228.

The difficulties which the engineer meets in collecting a library of his own are always those of the extraordinary expense of specialized books, and the rapid changes which the knowledge of his subject is undergoing. These conditions act to deter many from attempting private collections beyond a few standard essentials or the accepted "pocket book" of their particular profession. And so an obligation rests upon the public library to make for its community a single effort which shall secure to every man a library virtually his own, and guarantee an efficiency and economy of administration and breadth of resource beyond the possibility of individual effort.

The Pratt Free Library tries to meet the problem in this way—the Applied Science Room is the working reference library and news reading room. The books reserved there are a selection representing the most approved practice in the various engineering branches, subject to constant revision and expansion with the appearance of newer and better books. More than 150 volumes stand to the credit of electric practice. There are also many files of bound periodicals, including a complete set of the *Electrical World* and the *Transactions* of the American Institute of Electrical Engineers, as well as the *Gazette* and *Specifications* of the U. S. Patent Office, and a file of over 1900 picked manufacturers' catalogues, with suitable indexes and helps for research. The trade catalog collection includes the Bulletins of the General Electric, the Westinghouse, Crocker-Wheeler, Western Electric, Fort Wayne and Sprague companies, besides catalogs of leading electrical supply houses. Current technical literature appears in over 130 journals grouped on reading tables by subject matter. Electricity has a table devoted exclusively to its own papers.

The important work of circulating technical books is not neglected. Admittance to the shelves in the lending department is allowed the public and liberal privileges for drawing books

ELECTRICAL LIBRARY.

are granted to all borrowers. The circulating department keeps abreast of the Applied Science Room in developing along engineering lines.

The writer of this brief sketch, who conducts the Applied Science Department, expects and desires to lend his services to every visitor in the search of information required. All electrical men residing or sojourning in or about Greater New York are asked to feel a claim upon this department, and to take advantage of it as occasion arises. The Pratt Institute Free Library, on Ryerson Street, near DeKalb Avenue, is easily reached from Manhattan or different parts of Brooklyn by the Lexington Avenue L, and the Myrtle or DeKalb Avenue surface car lines.

Municipal Lighting in Disfavor at Middleboro, Mass.

Citizens of Middleboro, Mass., have become greatly dissatisfied with municipal electric lighting in that community, and a consumers' petition for reduced charges will probably be presented within a short time to the State Board of Gas and Electric Light Commissioners for hearing and adjudication. When consumers received their bills a few days ago for service riders were found stating that hereafter there would be minimum charges of $12 per year for gas, and the same amount for electricity. A charge of $2 per year is also made for the use of meters. As a result, a strong sentiment has developed locally in favor of selling the plant to a private corporation. Many of the consumers have refused to pay the extra charge and have defied the local electric light board to cut off their service. Others state that they will go back to oil lamps before paying additional charges.

Superintendent Philbrook, of the lighting department, states that an order was passed several years ago by the local lighting board putting this rate into effect, but that he never has seen any public notice of it. It will cost $2 per year per meter for repairs, whether the meters are used or not. At the coming town meeting in March the matter will be taken up, and there is already a movement to sell the plant to private interests.

Memphis Central-Station Expansion.

The Merchants' Power Company, of Memphis, Tenn., will shortly build an annex to its steam plant on the outskirts of the city at a cost of about $50,000. About 1500 hp in additional generating capacity will be installed in the shape of a turbo-generator outfit. The principal business of the company has until lately been the lighting by underground service of the stores in the heart of the business district of the city. Practically all the distribution is now underground. The company competes with the Consolidated Gas & Electric Company, which is a progressive and active organization, paying particular attention to power requirements as well as illumination.

Non-Renewable Incandescent Lamps.

Two patents were granted Jan. 12 to Matthew M. Merritt, of Middleton, Mass., having for their object to prevent or render commercially impracticable the renewal of incandescent lamps, or in other words, the substitution of a new filament for the old one when the latter is burned out or otherwise useless or inefficient. The specification states that the means provided to this end render access difficult to the ends of the leading-in wires and in particular prevent or obstruct both the wiping and the raking action incidental to the installation of a new filament. This is accomplished by the use of a guard of porcelain or other suitable material consisting of a disk secured, in the case of an anchored filament, to the anchor wire about the same distance from the stem as the pasted joints and provided with diametrically opposite notches through which the ends of the leading-in wires pass. The anchor wire support may also be weakened so that while having sufficient strength to support the filament and guard, any attempt to remove the latter will break the anchor wire. Another form of guard is described which is stated to prevent effectually the use of any tool for working over the ends of platinum wires while the guard is in position.

Electric Railway Operations in Massachusetts.

The advance copy of the Massachusetts Railroad Commission's fortieth annual report was submitted to the Legislature on its assembly Jan. 6. The report covers the operations of 81 companies, of which 39 paid dividends averaging 5.29 per cent on the capital stock. In 1907 the average rate of dividends was 5.08 per cent. There are now 2848 miles of single track owned by electric railways in the State, an increase of 23.7 miles over 1907. The dividends paid ranged from 10 per cent to 1 per cent. The average cost of the street railways of the State per mile of main track, including the cost but not the length of side track, was $31,004 for construction, $11,103 for equipment, and $15,568 for land, buildings and other permanent equipment, making a total of $57,676 per mile. The capital investment per mile was $57,521, including the outstanding stock and the net debt.

The income of all the companies in the State for the year was $32,462,332, representing an increase of $259,000 over 1907. The operating expenses were $20,541,577, a decrease of $148,-091 from 1907. The surplus for the year was $259,785 less than for the previous year. Since 1899 the capital investment per mile has increased about $12,480, and the total cost of the lines per mile about $14,700. The principal increase has been in the cost of construction, $8,200 per mile. The total car miles run in 1908, year ending Sept. 30, were 116,982,089 compared with 117,719,203 in 1907. The car miles run 10 years ago, in 1899, were 73,367,235. In this period the density of traffic in passengers per mile of main track operated has increased from a minimum of 188,787, in 1902, to 219,774 in 1908. The ratio of operating expenses to gross earnings dropped from 67.71 per cent in 1907 to 66.73 in 1908. The gross earnings per mile were $11,507. The net earnings per mile were $3,828, compared with $3,709 the preceding year. The average gross earnings per car mile were 26.31 cents, operating expenses, 17.56 cents, and net earnings, 8.75 cents, compared with 25.96 cents, 17.58 cents and 8.38 cents a year ago. The average gross earnings per passenger were 5.11 cents, operating expenses 3.41 cents and net earnings, 1.70 cents.

Municipal Electric Lighting Results at Wellesley, Mass.

Recent figures of operating results in the electric light department of the town of Wellesley, Mass., which purchases current from the Edison Electric Illuminating Company of Boston, show that the plan of buying electrical energy from a large central station and then selling it under the auspices of the local community is thoroughly successful. By this arrangement the town is treated like any other large consumer of electrical energy, current being delivered to it at a substation owned by the town in Wellesley Hills at a wholesale rate which is not expected to exceed four cents per kw-hour, according to the demand and total consumption. All the electricity used in Wellesley is generated at the L Street station of the Boston Edison Company, which is about 17 miles distant from the town substation. The transmission is by 6600-volt circuits. For local distribution in the town of Wellesley and in the Wellesley Hills section, the potential is reduced to about 2300 volts. All the commercial work of the town is handled by the electric light department, which has nothing to do with the generation of the current, but which oversees its distribution for street lighting, commercial lighting and general service, and for power.

In the year 1907 the electric light department devoted much time to getting into final running order, making arrangements for keeping supplies at the substation, and keeping complete records of all stock used. Complete records of the amount and voltage of the current passing through the substation were kept. The average cost of the current to the town at the switchboard of the substation was 3.90 cents per kw-hour. In 1907 about $920 was expended on the street-lighting system, and about $3,870 on the commercial-lighting service, making the total cost of the plant at the end of that year about $66,000. The value of the old street lighting system was taken at $12,000 at the time the contract was signed with the Boston Edison Company.

The department has aimed so far as possible to make house connections by underground construction, removing from the high-class residential territory all unsightly fixtures. Considerable trouble from broken lamps was experienced, some 187 cases occurring in the year. During 1907 about two miles of additional street-lighting wire were installed, and in the year as a whole there was an average of 774 street series lamps lighted daily, and the total number of hours of burning was 4400. In the fall of 1908 it was voted to burn lamps until morning, with the idea of continuing this service all night if it was successful. Early in 1909 it was decided to supply the service all night. The number of commercial subscribers increased from 280 to 321 in the year 1907, and the town renewed 3655 commercial lamps. Carbon-filament lamps of the ordinary type are renewed free, in case the inside of the glass is darkened or the filament is broken, but not otherwise. In 1907 a total of 1667 new lamps were installed, in new installations.

In 1907 the total number of kw-hours metered at the substation was 343,751. The commercial circuits used 251,120 kw-hours, and the substation itself 800 kw-hours. The cost of supplying the substation's own energy was thus less than 75 cents per week. The balance of current metered was delivered to the street-lighting panels in the substation. The consumers' meters registered 129,840 kw-hours, and the loss in the commercial circuits was 44 per cent. The net income of the department was about $17,000 or approximately $2.75 per capita. The service is almost entirely residential, although there were power sales amounting to about $500 in 1907. The cost of operating the department in the year, including salaries, construction, maintenance and interest, was about $30,000, of which the cost

of current was about $13,300. The rates for power charged are 11 cents per kw-hour, and for lighting, 14 cents, with 10 per cent discount on each class of service. The difference in the cost at the substation to the town and the prices charged to consumers goes into the street lighting expense, besides paying other necessary operating and fixed charges.

The latest results at hand are those for the fiscal year ending June 30, 1908, the returns for the complete year 1908 not yet being available. In this period the current purchased cost on the average 3.96 cents per kw-hour, and the Edison company delivered at the substation 354,690 kw-hours, representing a gain in business of 3.2 per cent over the previous figures quoted. Station wages were $840, or about 0.24 cent per kw-hour delivered at the substation, showing a cost per unit of from 30 to 50 per cent of the labor often required in small steam plants independently operated. Compared with the labor cost of the Edison company itself in its large stations, the cost of handling the input at the Wellesley substation is about the same per unit; and as there is practically no rotating machinery in the substation, a growth in the load will constantly decrease the cost of substation labor per kw-hour. In addition, the town has the advantage of being able to draw upon a practically unlimited supply of power, and the reliability of the service is much greater than in a small station of moderate capacity with apparatus not representing the latest developments of engineering design.

The maximum load in the substation was 131 kw. Small as this is, it brought for the business of the fiscal year a revenue of $14,000 to the Edison company. Substation repairs came to $32.70, and station tools and appliances to $122. The total cost of substation operation was therefore $995, or 0.28 cent per kw-hour. The cost of distribution was $3,208, and the town sold a total of 332,662 kw-hours. The minimum load was 16 kw. The work was handled by one foreman, one outside man and one substation man. By the arrangement now in force, the Edison company gets rid of all the detail work within the town, and is not required to meet the expense of bookkeeping, billing, meter reading, etc. At the same time the company maintains friendly relations with the town in every way, and is ready to do anything it legitimately can to facilitate the extension of electrical service according to the best plans. The employees of the exhibition department in Boston are available at all times to do anything in their power to popularize electrical service, in Wellesley as well as in Boston proper.

CURRENT NEWS AND NOTES.

WORCESTER (MASS.) EXPOSITION.—It is proposed by the Worcester County Mechanics' Association to have a mechanical and electrical exposition from March 27 to April 3, this year, in the Mechanics' Hall Building. Mr. H. F. Campbell is the superintendent.

OMAHA ELECTRICAL SHOW.—A number of the leading electrical supply houses and contractors of Omaha, Neb., and Council Bluffs are arranging to give an electrical show May 6-15 inclusive. Mr. G. W. Johnston is the president of the organization; A. G. Munro, vice-president; W. L. Burgess, secretary; J. R. Lehmer, treasurer, and J. M. Gillan, manager. The show will be given at the Auditorium.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.—The date of the meeting of the Electrical Committee of the Underwriters' National Electric Association has been fixed for Wednesday and Thursday, March 24 and 25, at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York City, beginning at 10 o'clock on Wednesday morning.

WINNIPEG MUNICIPAL PLANT.—The Winnipeg (Man.) Electric Railway Company, which also controls the electric lighting plant, has made proposals to sell to the city its entire plant, or to reduce rates sufficiently to prevent the city from continuing work on its $5,000,000 municipal plant, designed for 60,000 hp. The company offered to sell electrical energy wholesale for $24.66 per hp-year to the city, the latter to resell at retail.

NEW JERSEY UTILITIES.—In his annual message to the New Jersey Legislature, Governor Fort urges the passing of a public utilities bill and says: "An intelligent, conservative board of public utilities commissioners, with adequate powers, will strengthen public confidence in the securities of all such companies and prevent harm to any interests. There is absolutely no reason not founded in cupidity against a public utilities commission." The State Board of Agriculture has now recommended such a commission.

PROPOSED RESTRICTION OF FRANCHISES IN INDIANA.—Governor Marshall, of Indiana, in his inaugural address recommended to the Legislature the passage of a law that will prohibit municipalities from granting franchises to public service corporations until the price the public is to pay to enjoy them is positively defined, and the municipality is allowed to share in the profits arising from operation. Further, after those things have been provided for, no second franchise shall be granted until the first has been annulled for fraud or failure to serve the public honestly and efficiently.

INDIANA ELECTRIC LIGHT ASSOCIATION.—A special meeting of the newly formed Indiana Electric Light Association is to be held at the Claypool Hotel, Indianapolis, on Jan. 26, when an interesting meeting is expected. The morning session will be given up to the meetings of the executive and advisory committees. The afternoon session will be occupied with papers and discussions as follows: "Effect of Public Utility Legislation," Henry L. Doherty; "The Tungsten Lamp," R. M. Cass, of the Indianapolis Light & Heat Company; "District Heating from Central Stations," S. B. Hofft, Merchants' Heat & Light Company, Indianapolis.

ELECTRICAL FIRES.—For years it has been the custom of the newspapers of Rochester, N. Y., to ascribe as a cause for all fires otherwise unaccounted for defective electric wiring. Recently the Rochester Railway & Light Company has had a fire-alarm system installed so that a corps of linemen respond to every fire in the city. The linemen look after the company's circuits and in numerous ways expedite the work of the firemen. Incidentally, by this means the company is apprised of the causes of all fires and an offending newspaper is called to account. One of the Rochester papers published an account of a large fire recently and in its dilemma said "as there was no electric wiring in the building, the fire could not be accounted for." In this way did the aggrieved reporter mete out retribution.

POWER PROJECT VETOED.—Consistently with his general attitude toward power enterprises, as expressed in recent documents and actions, President Roosevelt has sent to Congress a special message vetoing the bill for the construction of a dam across the James River, Stone County, Missouri, for hydro-electric purposes. He declares characteristically that the movement to secure control of the water power of the country is still in its infancy, but that "unless it is controlled the history of the oil industry will be repeated in the hydro-electric power industry, with results far more oppressive and disastrous for the people. It is true," he added, "that the great bulk of our potential water power is as yet undeveloped, but the sites which are now controlled by combinations are those which offer the greatest advantages, and therefore hold a strategic position." He says that "the bill gives to the grantee a valuable privilege, which by its very nature is monopolistic, and does not contain the conditions essential to protect the public interest. I consider myself bound," he continues, "as far as exercise of my executive power will allow, to do for

the people, in prevention of monopoly of their resources, what I believe they would do for themselves if they were in a position to act."

ELECTRIFICATION OF MICHIGAN CENTRAL.—It is reported that the Michigan Central Railroad will electrify its terminals at Detroit and also the main line to Ypsilanti, a distance of 30 miles.

MINNESOTA PUBLIC SERVICE COMMISSION.—Governor Johnson in his annual message to the Minnesota Legislature strongly advocates the passage of a public utility law like that of Massachusetts, New York and Wisconsin.

LAND FOR COMMONWEALTH EDISON.—The Commonwealth Edison Company of Chicago has increased its holdings of land in the vicinity of its great Fisk Street station by the purchase of a tract 1040 ft. x 248 ft. on Center Avenue, adjoining its Fisk Street property. This land will not be occupied at once, as it is under lease to another party and has been purchased to provide for future needs under the far-sighted policy developed by the management.

ENGINEER, INDIAN SERVICE.—The United States Civil Service Commission will conduct an examination on Feb. 17 for a vacancy in the position of engineer at $720 per annum in the Indian Service at Fort Berthold, North Dakota. The salaries for selected candidates range from $480 to $1,000. The age limit is 20 years and over. The subjects are steam and electrical engineering, heating, refrigeration, hydraulics, gas engines, etc. Details can be obtained from the commission in Washington.

VIRGIN TO THE TELEPHONE.—There are probably a good many people in the United States who have never used a trolley car or a telephone, but probably they are not "leading citizens." In London, Judge Willis, of the Southwark County Court, has just confessed that he never used the telephone. He admitted that on several occasions he had seen the instrument in public places, but had never spoken or listened—had never felt an inner suggestion that he do so—and expected that he would never meet an emergency that would suggest it.

LONG TELEGRAPH CIRCUIT.—During the recent floods in Montana communication by telegraph and railroad between the cities of Butte and Missoula was interrupted for six weeks by a washout. The distance between the two places is 126 miles. A special dispatch was filed one night in the Butte office of the Postal Telegraph & Cable Company for a newspaper in Missoula, but as there were no direct wires a special circuit was made up as follows: From Butte to Chicago, St. Louis, Denver, Albuquerque, N. Mex., Los Angeles, Cal., San Francisco, Seattle, Wash., to Missoula, Mont. The length of this circuit was 7000 miles. The circuit, which was worked duplex throughout, passed through 15 States and Territories. It took just three minutes to organize it and get it to work.

TRACTION ACCIDENTS IN NEW YORK.—The returns secured by the Public Service Commission of the First District show that in New York City during 1908 444 persons were killed in "accidents" on the traction lines of all kinds, and 35,060 were injured. The figures do not reveal how many of these cases were due to personal negligence. Including the people killed, the cases of serious injury appear to the number of 2591. Of this total, 268 cases occurred on the steam lines, 302 on the elevated and subway lines and 2023 on the surface lines. June was the favorite month for casualties, but October had the fattest death roll. The fact may be noted, however, that the car lines in New York City carried 1,300,000,000 passengers in the year, or 60 per cent more than all the steam railroads of the country.

BOSTON Y. M. C. A. ELECTRICAL LECTURES.—Several lectures more or less related to the electrical industries are to be given this winter before the Boston Young Men's Christian Union in the thirty-seventh annual series of "Talks." On Jan. 9, Prof. George F. Swain, of the Massachusetts Institute of Technology, was scheduled to speak on "The Conservation of Our Natural Resources." On Jan. 16, Mr. J. Henry Neal, general auditor of the Boston Elevated Railway Company, will discuss "The Building of a Great Street Railway System"; Feb. 13, Mr. Francis W. Wilcox, of the General Electric Company, Harrison, N. J., will speak on the "Development of the Incandescent Lamp," and on Feb. 27, James O. Fagan, signalman, Boston & Maine Railroad, will speak on "Life and Work on the Railroad."

CELEBRATION AT PITTSBURGH.—The employees of the engineering and laboratory departments of the Allegheny County Light Company held their first annual banquet Thursday evening, Jan. 7, at the Hotel Dorset, East Liberty, Pittsburgh, Pa. Covers were laid for 40 employees, and an electrical menu was greatly enjoyed. Mr. H. E. White acted as toastmaster for the occasion. After all were seated, an electric sign, "Allegheny County Light Company," was turned on, all in red and white incandescent lamps, the room also being decorated with red and white incandescent lamps. After the dinner was served the toastmaster introduced Mr. H. N. Muller, electrical engineer of the company, who spoke to the employees upon the great demand for good, efficient men in the various electric lines. At the close of his address a short musical program was enjoyed. Several selections were given by the men's quartet from the laboratory. Other employees responded with short talks.

VALUATION OF PROPERTY.—D. D. Mann, representing the Winnipeg Electric Railway, met the power committee of the City Council of Winnipeg, Man., on Jan. 16, to discuss the sale of the property of the Winnipeg Electric Railway to the city. Mayor Evans said that the city was willing to take over the holdings of the company at a fair valuation, and asked Mr. Mann to set a price on the property. Mr. Mann said he could not act without the authority of the directors of the company, but that he knew that no arrangement for the sale to the city would be entertained by them if it did not provide for a consideration for the franchise. This value, he said, the directors felt should be fixed at 6 per cent of the annual net earnings of the company. This would mean that on the earnings of 1907 the company would want $16,645,000 for its property, and on the earnings of 1908 about $19,000,000. After the meeting, the Mayor and several Aldermen said that they considered the price proposed as excessive.

THE COLLEGE MAN.—In a recent communication to one of the journals published at Yale University, Mr. E. H. Harriman, the railroad magnate, says with regard to education: "A college education will be a great help if the man in going through college has kept the foundations of high school learning firmly fixed. On the other hand, if he has neglected his handwriting and forgotten his arithmetic in higher mathematics, nothing could be worse for him. If, however, he still retains these essentials he has a great advantage in that he has a broader view of the world and a greater knowledge of how to learn. Thus college education is, in the beginning, a real disadvantage, and I have found that in every case the high school boy does better work than the college man for the first few years. However, as soon as the college man has overcome these habits and has got back to first principles, he will go ahead much faster than his less educated rival. His mind is, naturally, better developed and more capable of grasping the fine points of the business. On the other hand, the high school boy as being younger is more adaptable and has not in most cases the irregular habits of the college man. No matter how well educated a man may be he must start in railroading at the very bottom."

Station No. 3 of the Rochester Railway & Light Company.

AS pointed out in last issue, the water power furnished by the Genesee River at Rochester, while practically unlimited during a short season of the year, falls to so low a point during the other portions that it is only possible at times to get enough water from Brown's Race to run the condensers for the engines. Water storage on the Genesee River has been discussed from time to time, but thus far nothing has been done. The New York State Water Supply Commission in its report, just issued, has recommended the erection of a storage dam capable of holding 18,000,000,000 cu. ft. of water at Portageville, N. Y. This amount has been estimated to be sufficient to provide a yearly average flow of 800 cu. ft. of water per second for power purposes and will increase by nearly 20,000 the actual 24-hour horse-power now developed at Rochester. Inasmuch as the scheme of pondage at Portageville will cost in the neighborhood of $10,000,000, which would be apportioned among the benefited districts, there is little likelihood of the plan being carried through for at least some time to come. It is necessary, therefore, for the Rochester Railway & Light Company to keep some steam-driven stations in operation. The largest of these is known as Station No. 3, and it is located on Brown's Race at about the geographical center of the city.

The station is built on the westerly bank of the Genesee against the rocky cliff. The solid rock extending from the race on the west at an elevation of about 100 ft. above low water was channeled down to about a grade of 58 ft. for the main floor of the boiler room. Below this for a distance of 10 ft. is a basement for the ash hoppers and ash troughs, while toward the river there is another step cut in the rock 30 ft. below the boiler room basement for the engine room. The latter room has mezzanine floors on either side which support steam piping, condensers and other auxiliary apparatus. The engine room proper is approximately 76 ft. square inside of the columns supporting the galleries and is spanned by an electric traveling crane of 35 tons capacity. The engines are set in two lines running north and south, with the shafts running east and west, leaving a 10-ft. aisle between the two lines of machines.

The roof of the boiler room is slightly higher than the street and between the building and the street runs Brown's Race, which comes within 10 ft. of the southerly end of the building. A bridge spans the race and over this all the coal and other fuel used in the station is passed. The boiler room is approximately 89 ft. x 69 ft. in the clear. Above the boilers is a coal pocket, which is 21 ft. wide at the bottom with sides sloping at 45 deg., and 17½ ft. high to the bottom of the boiler-house roof beams. The boiler fronts, stokers, concrete ash hoppers and part of the side walls of the boilers are supported by the main boiler-room floor; but the boiler drums and tube sections are hung from pairs of 15-in. I-beams which frame into the horizontal coal-pocket girders. The roof over the boiler house is made sufficiently strong to support coal wagons, which dump directly into the 1300-ton coal pocket through any one of 18 coal holes. The pocket is filled without trimming by hand by this means. The bridge forming a runway over the race has a 5 per cent grade, so that teams have no difficulty in delivering the coal to the roof. Fig. 2 shows a view of the runway leading to the roof of the station and also shows the cable runway to a cable tower on the west side of the race. Over the latter

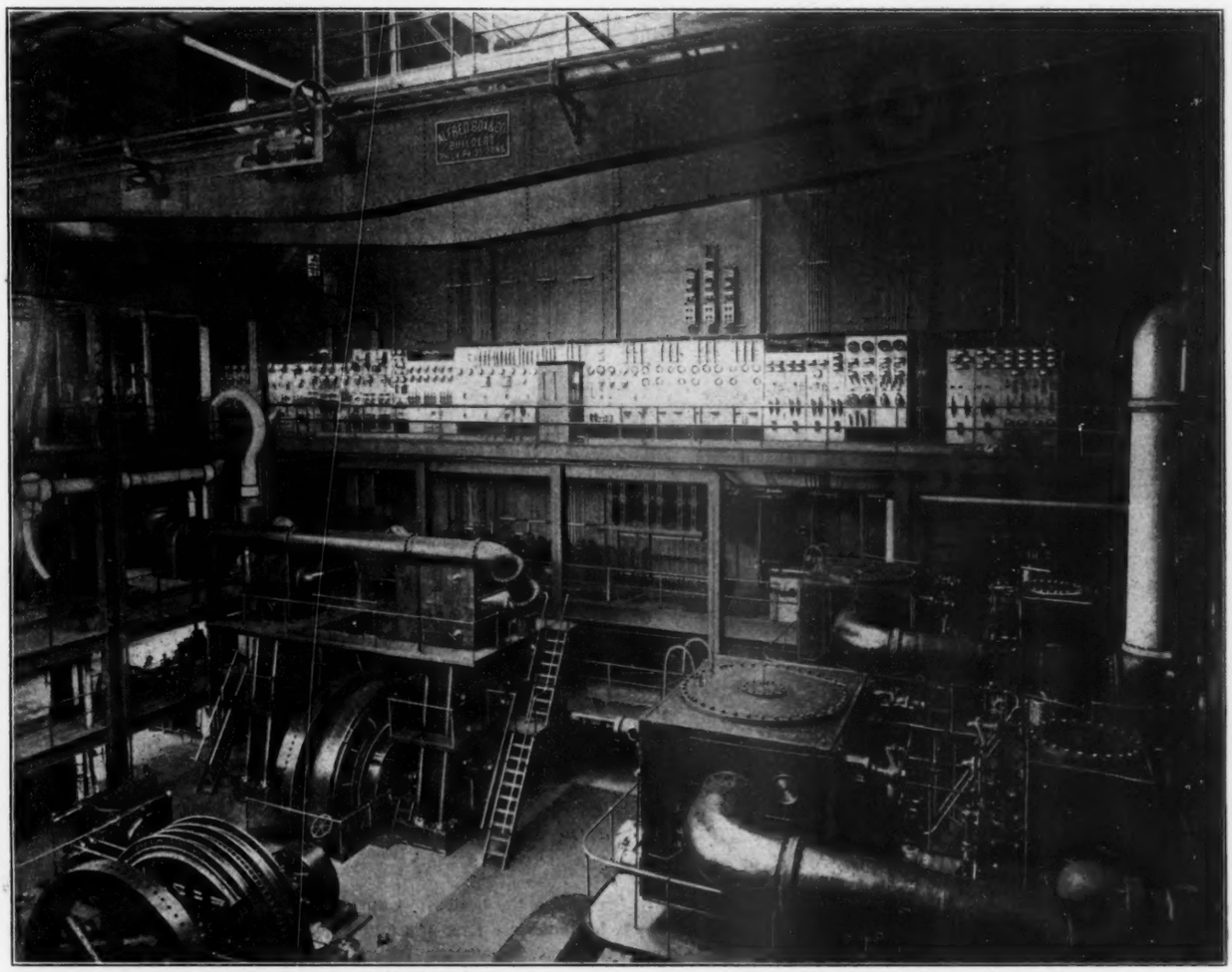

FIG. 1.—GENERAL VIEW OF GENERATOR ROOM OF STATION NO. 3 OF THE ROCHESTER RAILWAY & LIGHT COMPANY.

runway many of the cables leaving the station are taken to underground conduits.

The foundations for the stacks are also in the boiler-house roof. The stacks themselves are 178 ft. above the base or foundation girders and are 10 ft. 3 in. in diameter. For 20 ft. above the base they are lined with firebrick. The stacks stand 41 ft. center to center, and their tops are approximately 185 ft. above the furnace grates. The up-takes from the boilers go directly upward into the bottom of the flue, which extends the length of the boiler house on each side and discharges into the bottom of the stacks near the center of the station.

The boiler equipment comprises 10 Aultman & Taylor water-tube boilers, each of which is rated at 650 hp. The boilers are set in four batteries of two each, occupying the four corners of the boiler house, with a single boiler set in the center of either side occupying the space immediately under the stacks. The boilers are set with no space behind them, cleaning doors being provided at the side instead of in the back. Two of the boilers are at present equipped for burning fuel oil, and the others are fitted with Ross stokers, made by the Harrisburg Foundry & Machine Works. Experiments made during the past year have caused the company to decide on a change in

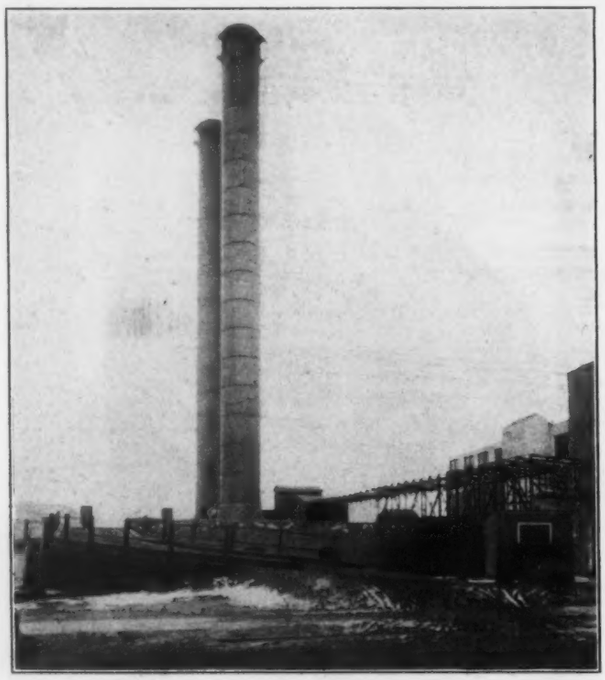

FIG. 2.—DRIVEWAY LEADING FROM STREET TO ROOF OF STATION.

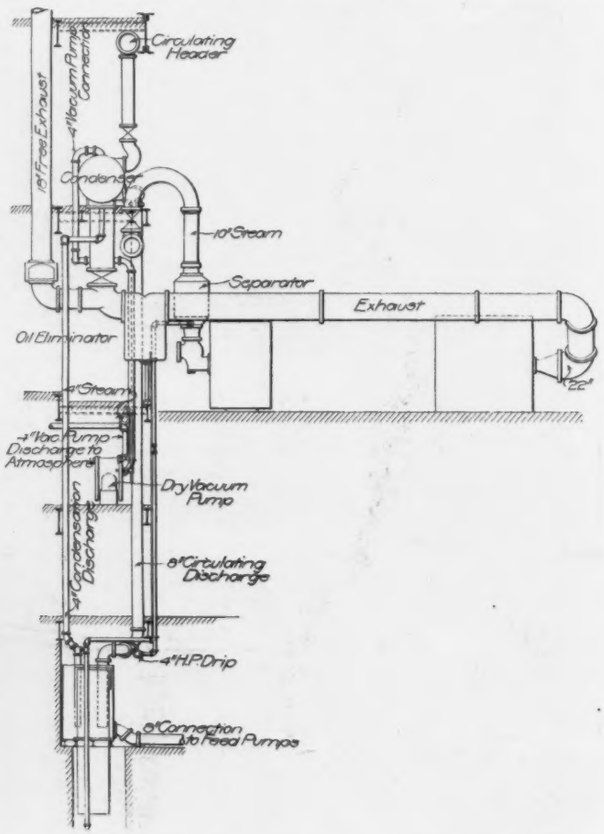

FIG. 3.—STEAM PIPE CONNECTIONS TO LARGE ENGINES.

the boiler layout. The four boilers fitted with Ross stokers of the older type will have their furnaces changed. The fire box will be lowered 7 ft. into the basement, leaving a combustion chamber between the grates of the stoker and the bottom tubes approximately 12 ft. high and 5 ft. deep, the setting otherwise remaining the same. The boiler front, from the stoker to the lower tubes, will be lined with firebrick, and the bridge wall will, of course, be carried down to the bottom of the stoker pit. There is also an inclined firebrick arch over the coking grates which continues a suitable distance over the incandescent fuel. This serves as a sort of retort for coking the fuel and the gases being completely burned in the combustion chamber, there is an absence of smoke.

The effect of this deepening chamber is somewhat similar to that of a Dutch oven and after trying the scheme out on one boiler the company is so pleased with the results that the change in the others will be made shortly. In addition, experiments made on oil fuel have caused the company to decide to equip four boilers for burning fuel, but the exact form of setting has not been decided on as yet. Texas crude oil will be used. The oil is brought in cars, and from the latter flows by gravity to a 750,000-gal. tank standing 90 ft. below the track level. An auxiliary tank, 10 ft. below the track level feeds directly to the boilers, so that the oil will run from the cars to the storage tank and thence up to the auxiliary tank. The oil can also be pumped from the storage tank. So far as cost is concerned present experiments indicate that, considering the cost of coal alone and the cost of oil alone, it is more expensive to use the oil. From the viewpoint of upkeep, however, including labor, it is estimated that the oil will show a small saving. The chief advantage of the scheme, however, is the absence of smoke, the ease of operation and above all the rapidity with which the boilers can be made to generate steam, starting with the boilers cold.

The two remaining boilers are fitted with the improved type of Ross stokers, and these will not be changed. A very interesting change will be made, however, in the flues and method of running the boilers. Considering one row of boilers and numbering these 1, 2, 3, 4 and 5: boilers No. 1 and No. 5 will have depressed furnaces, boilers No. 2 and No. 4 will be fitted for oil burning and boiler No. 3 will remain unchanged. The coal-burning boilers will carry the steady load, and the gases will be constrained to pass from boilers No. 1 and No. 5 through boilers No. 2 and No. 4 and out through boiler No. 5 to the stack. If it is necessary to employ a fan to obtain the necessary draft in view of the circuitous route of the gases, a fan will be installed. Normally, the oil-burning boilers will not be operating only on varying load and at peaks. The boilers will, therefore, act as sort of economizers, and the arrangement will in all probability result in the generation of low-pressure steam at least. In cases of emergency, the oil-burning boilers can be brought into use at once and steam generated in about 20 minutes.

The Ross stoker is designed for burning bituminous coal, such as is used at Rochester, and which costs about $2.50 per ton. After the fuel leaves the coking plate and grates it passes down the inclined grates, each alternate bar being arranged to rise

at the lower end and move forward, breaking up and carrying the fuel downward toward the dumping grate at the bottom, making a constant and positive feed at all times. Separate adjustments control the movements of the coal pusher, coking grates and inclined grates, which are all independent. A series of small coking grates are hung from a rocking bar and arranged to move forward and backward in a horizontal direction. Their function is to carry the coal and coke from the dead plate to the main inclined grates. The latter are alternately movable and stationary. The movable grates are controlled by a regulator on the front of the stoker and move to a height of 4 in. upward and forward at the lower end and then backward level with the stationary grates. They are straight from the upper end to the dump grates and provided with overlapping and vertical flights on their sides so arranged that a suitable supply of air will pass between them. The dumping ash grate is balanced and reversible, and is operated by levers in front.

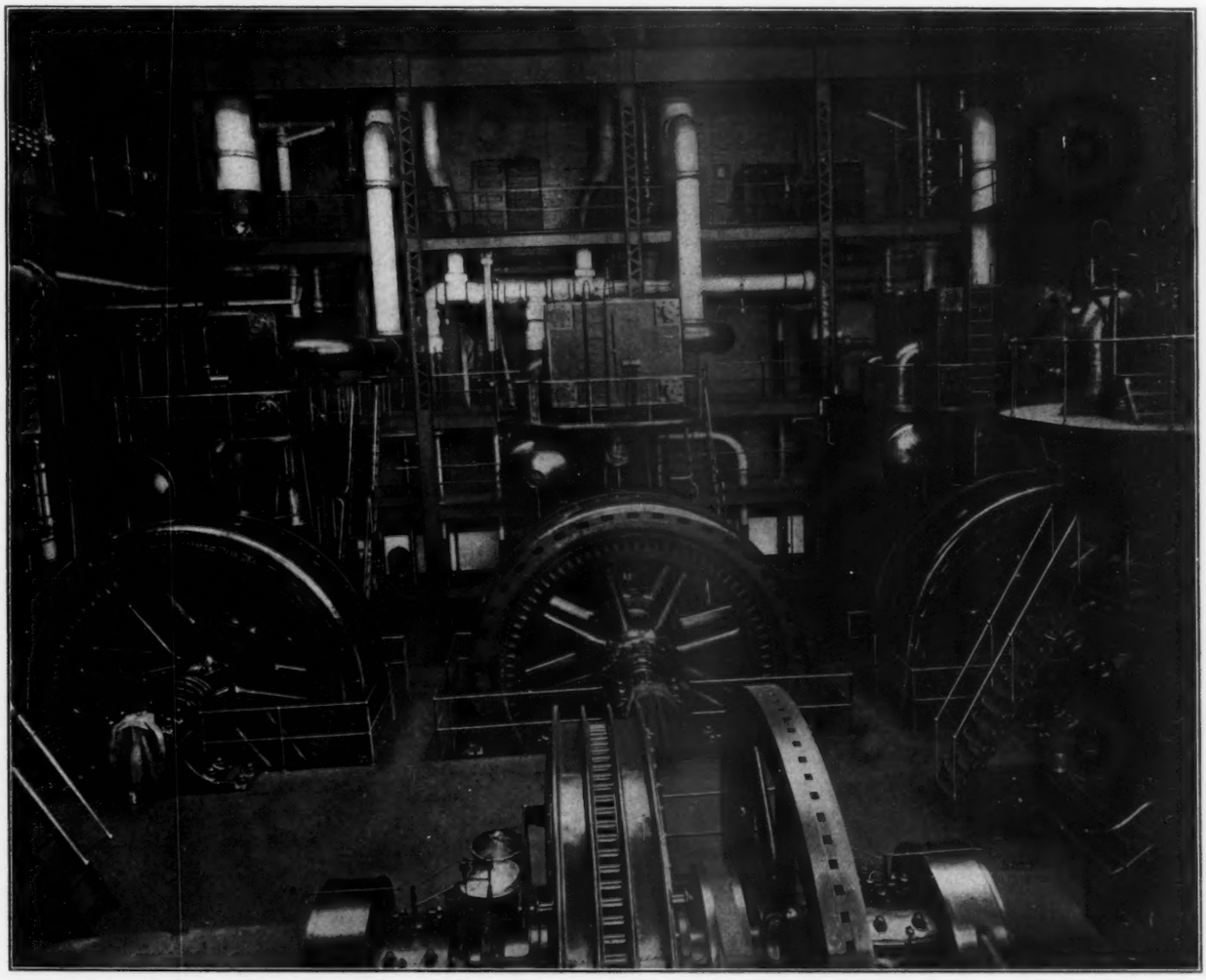

FIG. 4.—VIEW OF ENGINES ALONG WEST WALL SHOWING STEAM PIPING.

The engine room, a view of which is shown in Fig. 1, is some distance above the river and has mezzanine floors on the east and west sides 6 ft. 10 in. wide. The first two mezzanine floors are on the same level with the engine platforms, the third mezzanine floor is on the same level as the main electrical-control floor and carries the primary and secondary feed-water heaters, and the fourth mezzanine floor is 6 in. below the top of the crane girders. Along the west side of the engine room are three vertical cross-compound engines, built by the Southwark Foundry & Machine Company, of Philadelphia. Each engine is arranged to drive a 1360-kw, 4150-volt, 60-cycle alternator placed between the low-pressure side of the engine and an outer pedestal. The engines are designed to run at a normal speed of 90 r.p.m., with an initial steam pressure of 160 lb. and a vacuum of 26 in. Under these conditions each engine will develop 1800 hp at 30 per cent cut-off and a maximum of 3000 hp. When running with most economical load, they require less than 13 lb. of dry steam per ihp per hour, including the steam used in the reheater, while the steam variation from no-load to full-load does not exceed 3 per cent from the normal. Under any change of load, the speed variation is said not to exceed one-fourth of one geometrical degree from the position of uniform rotation. The flywheel of each engine is 20 ft. in diameter and weighs, with the armature sleeve, close to 125,000 lb. The flywheel is made of cast-iron segments securely held together at the rim by tee-headed shrunk links and at the hub by means of fitted bolts. The armature sleeve is bolted directly to the spokes of the generator, thus relieving the shaft of any strain between the flywheel and generator. The engines are fitted with Porter-type governors capable of electrical control from the switchboard for synchronizing purposes. A Bulkley condenser is provided with each of the three engines. The usual automatic, free exhaust valve and connections are placed in each of the exhaust pipes and two Hoppes open heaters with 1750 ft. of scale-catching surface, are connected to the engine exhaust pipe. The feed water is taken from the hot well, race, river or from the city water mains and is handled by three duplex, outside-packed plunger pumps. These pumps are designed to work against 250-lb. water pressure and any one is sufficiently large to handle the entire installation. From the pumps the feed water is taken through the Hoppes heaters and thence into the feed mains, which run underneath the boilers

immediately in front of the ash hoppers, where connections are made to vertical lines at the side of the boiler. The steam pipe connections for the three Southwark engines is shown in Fig. 4. The door shown on the upper mezzanine floor leads into the boiler room, being a few feet above the boiler-room floor. The main steam header supplying the engines is shown directly below and the two feeders from the boiler room are shown coming down at either side of the door.

Along the east side of the engine room there are two engines and a steam turbine; the Dickson engine shown in the foreground of Figs. 1 and 4 having been removed and a turbine placed there instead. The engine near the switchboard galleries is an 1800-hp, vertical cross-compound McIntosh & Seymour engine direct-connected to a 1000-kw railway generator. At the other end of the row is an 1800-hp Allis-Chalmers vertical cross-compound engine direct-connected to two 550-kw, 250-volt generators. Between these engines is a 3000-kw Curtis turbine driving a 4150-volt, three-phase alternator. The latter unit is fitted with an Alberger condenser, and the whole equipment requires less space than the old 500-kw Dickson-Stanley

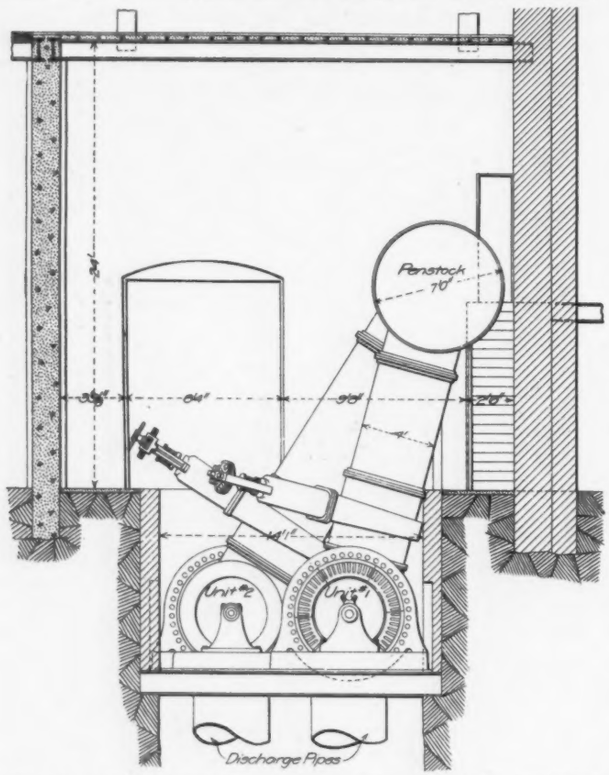

FIG. 5.—ARRANGEMENT OF WATERWHEELS IN ROOM ADJOINING STATION NO. 3.

set, which has been placed in Station No. 1 for reserve use. Fig. 3 shows the steam-pipe arrangements on the east side of the station, which do not differ greatly from that on the other side.

Normally when there is plenty of water in Brown's Race the condensing water is taken directly from the race without any pumping whatever, but during periods of slack water the condensing water is pumped from the river. The station possesses many advantages because of its peculiar location. Although coal must be carted to it, after it is dumped into the pocket there is no rehandling, nor is there any moving machinery employed in its distribution. The coal is delivered by gravity through chutes to the hoppers of the stokers. The ashes are dumped into a concrete trough under the furnace pits in the basement, whence they are washed into the river without further ado, and the whole problem of ash removal easily solved. Boiler feed water must be pumped because the tops of the boilers are not much below the level of the race, and at times water for condensing purposes must also be pumped. Ordinarily, however, there is enough water in the race so that the condensers may be fed by gravity from it, or, in other words, a spillway with intercepting condensers is provided at this point instead of farther down the river, where no advantage could be taken of it.

The generating apparatus in the station consists of three 4150-volt, three-phase, 60-cycle alternators, one 3000-kw turbo-alternator, one 1000-kw, 550-volt generator and two 550-kw, 250-volt generators. The three engine-driven alternators are of the Stanley type, and all the other generating apparatus is of General Electric type. In addition there are two 250-kw, 550-volt Bullock motor-generator sets used to feed a 500-volt motor circuit; a 500-kw, 550-volt General Electric motor-generator set for street railway work, a 90-kw, 125-volt General Electric motor-generator sets for excitation purposes; two 150-kw Edison machines direct-coupled to a 250-volt Edison generator used as a motor, also for exciter purposes; a 1000-kw chloride battery for railway work; a 640-amp-hour battery floating on the exciter bus and capable of supplying the entire excitation energy required by the station for one hour; a 500-kw, 275-volt motor-generator set for feeding the Edison system at this point, and a 125-hp motor direct-connected to a generator. This last set is used in connection with the railway battery for booster purposes and is arranged with carbon regulator. There are also in use for excitation purposes a 75-kw steam-driven set and induction-motor exciter set. The steam-driven set is used so as to make the excitation independent of any electrical disturbance which might affect the regular operation of the system, and also on account of the relatively high economy realized by utilizing the exhaust steam to heat the boiler feed water, as the station has no other steam auxiliaries except the boiler feed-pumps, stoker engines and condenser pumps.

Adjacent to the steam plant of Station No. 3 is an old water-power plant taking water from Brown's Race through a 7-ft. penstock and having a head of about 90 ft. Heretofore the generators in this plant were driven from belts and ropes, but lately the plant has been reconstructed and direct-connected units installed. The arrangement of the units is shown in Fig. 5. There are two 350-kw, 4150-volt alternators and one 300-kw, 550-volt direct-current generator installed in this plant.

At the south side of the engine room are three galleries set aside for electrical purposes. The two lower galleries are 12 ft. 6 in. wide, and the one on which the switchboard is placed is about 16 ft. wide. An addition is built to the southeast corner of the engine room which extends the full height of the building, 18½ ft. x 43 ft. In this switchboard and transforming apparatus is installed. All the electrical connections of the generators, exciters, etc., are brought to the operating switchboard in the gallery. The board is somewhat different from that shown in Fig. 1. Since the picture was taken the switchboard has been rebuilt to a large extent, although the general arrangement remains the same. There are now about 55 panels in the board, comprising panels for the generators, motors, tie lines, battery, railway feeders, Edison system feeders, alternating-current feeders, etc. The railway circuits are controlled from the left end of the board. The panels are standard throughout. but the excellence of the wiring back of the panels is worthy of comment. The oil switches are located on the gallery below and the constant-current transformers for the series arc-lamp circuits fed from this station are placed in the gallery above and to the left. From this station there are several three-phase distributing feeders for lamp and motor circuits, and on these circuits potential regulators are arranged. These are placed back of the switchboard. The exciter circuits run directly from the machines to the bus in conduit. All wiring from the transformers to the switchboard is in conduit with outlet boxes at the bottom of the board for the relay connections and at the top for the instrument connections. Condulets are used for outlets, and all the wiring being encased, the back of the board is singularly free from danger of contact. The motor-generator sets are located on the third gallery below the switchboard.

Station No. 3, being the main steam generating station of the company, is electrically connected with many of the other sta-

tions through numerous tie lines. There are tie lines to Station No. 2 on the Upper Falls for both railway and Edison lighting circuits; alternating-current tie lines with Station No. 15 on the Middle Falls, with Station No. 5 on the Lower Falls, with Stations No. 4 and No. 6 on the Upper Falls and on Johnson & Seymour Race, respectively, and there is also a tie line for railway circuits with Station No. 5. Inasmuch as the other stations are also tied together it is possible to transfer the load from almost any station to Station No. 3 and vice versa. The advantage of having the various stations electrically connected was well shown during the recent drought. Stations No. 2 and No. 3 and Station No. 1, which is usually only run in cases of emergency, are the only steam stations of the company. In the absence of water the first two were run overloaded for 24 hours a day during the season of drought and the last was run for two hours a day on the peak load. The tie connections are run underground, some passing out underground directly from the station and others crossing the river to the opposite bank.

The Influence of Frequency on the Equivalent Circuits of Alternating-Current Transmission Lines.

By A. E. Kennelly.

If a pair of single-phase wires form an alternating-current transmission line, as indicated by $A\,B$ and $A'B'$ in Fig. 1, they naturally possess distributed electrostatic capacity as well as distributed resistance, inductance and leakage. The distributed capacity is indicated diagrammatically in the figure by the numerous parallel lines connecting the two wires. It is customary, however, to compute the electrical behavior of such lines in regard to voltage-drop, or other particulars, under any assigned load, by assuming that each wire is operated with all of its capacity (to zero potential) connected in a single condenser, or lumped sum, between the middle point O along each wire, and the zero-potential axis $G\,G$ midway between them, as shown in Fig. 2.

Similarly, if three equidistant wires are employed in a three-phase transmission system, as represented in Fig. 3, each pair will possess distributed capacity, indicated by the parallel shading, as well as distributed resistance, inductance and leakance. It is customary, however, to compute the electrical behavior of the lines, under any assigned conditions of load, by assuming that each wire is operated with all of its capacity (to zero potential) connected in a single condenser between the middle point O along each wire and the zero-potential, or neutral, axis, $G\,G$, of the system, as shown in Fig. 4. It is known that if the same length and size of each wire is used in the single-phase line (Fig. 1) as in the three-phase line (Fig. 3), and if the distance separating the wires is in each case the same, then the capacity to be inserted in each condenser of Fig. 4 is the same as that in each condenser of Fig. 2. The star-voltage of the three-phase system must, however, be considered as acting on each wire, in Fig. 4, to ground or zero potential, whereas only the half-voltage of the single-phase system must be applied to each wire, in Fig. 2, to ground or zero potential.

It follows, then, that whether a wire belongs to a single-phase transmission system, as in Figs. 1 and 2, or to a symmetrical three-phase transmission system, as in Figs. 3 and 4, it is always capable of being treated as a single separate wire with a condenser connected to ground at the middle point of its length, in the manner shown in Fig. 5. The same proposition applies, moreover, with suitable modifications in detail, to each wire in any multiphase system, whether the distances between the wires are symmetrical or not.

Any uniform transmission-line wire may, therefore, be regarded as consisting virtually of a reactance coil $A\,B$ (Fig. 5) of assigned resistance and inductance, with a simple condenser connected between its middle point O and the ground. If there be appreciable leakage or waste of energy of any kind in the dielectric, such as radiation or electric hysteresis, then a suitable conductive leak should be assigned to the condenser in shunt, or a suitable resistance should be inserted in series with the condenser.

This association of a divided reactance coil and condenser representing an actual line wire may be called the equivalent circuit of the line wire, or, briefly, the T, from the graphic resemblance.

If the total resistance and inductance of the T are respectively the same as those of the actual line wire, and also if the capacity of the condenser is equal to the total capacity of the wire to zero potential, then the T is a nominal electric imitation of the line-wire, disregarding the lumping of the capacity, and such a T may be called the *nominal* T of the line wire.

It has been shown elsewhere by the writer[1] that the nominal T requires to be corrected for lumpiness of capacity in a definite and simple manner. The correction is a function of the impressed frequency. The modified T, corrected for lumpiness, may be called the *equivalent* T of the line-wire considered. For any given length of line-wire, with uniform linear constants, worked at a single impressed frequency, there is one and only one equivalent T which is the complete substitute of the line-wire for all external conditions. That is, any uniform wire may be completely and precisely imitated in regard to all external relations by its equivalent T, so long as the wire is operated steadily at a single impressed frequency. Internally, or within the length of the line-wire, the distributions of current and voltage may differ considerably from those at the corresponding points of the equivalent T, and surges set up by electrical disturbances on the actual wire may differ both internally and externally from those on the equivalent T, but, in the steady state, the distributions of voltage, current and power

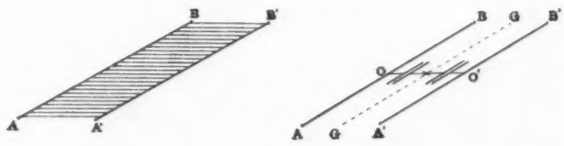

FIG. 1.—PAIR OF SINGLE-PHASE TRANSMISSION LINES. FIG. 2—NOMINAL EQUIVALENT CIRCUIT OF SINGLE-PHASE PAIR OF WIRES. TWO EQUAL CONDENSERS CONNECTED IN SERIES BETWEEN MID-LENGTH POINTS OO'.

at the line terminals, or at any point in the same system outside the line, will be the same with the actual wire as with its equivalent T.[2]

Again, if instead of connecting all the capacity of the wire at the center of its length, we connect half of this capacity at each end of the wire, as in Fig. 6, we shall obtain an equivalent circuit consisting of a single reactance coil with a condenser to ground at each end. This type of equivalent circuit may be called for brevity, a Π, from the graphical resemblance. As in the case of a T-conductor, if we import the nominal total values of wire resistance, inductance, leakance and capacity into the Π conductor, we obtain a nominal electric imitation of the line wire, except for the lumping of the capacity and leakance

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[1] "Artificial Lines for Continuous Currents in the Steady State," by A. E. Kennelly, *Proceedings* of the American Academy of Arts and Sciences, Vol. XLIV, No. 4, November, 1908, pp. 97-129.

[2] The correct impedance of each half AO, OB, of the reactance (Fig. 5) in the equivalent T is $z_0 \tanh \lambda\alpha$ ohms, and the correct impedance in the condenser branch is $z_0/\sinh L\alpha$ ohms; where z_0, the surge impedance of the wire, is a vector $z_0 = \sqrt{\frac{r + jl\omega}{g + jc\omega}}$ ohms, and α, the attenuation constant of the wire, is the vector:

$$\alpha = \sqrt{(r + jl\omega)(g + jc\omega)}$$ (hyp. per mile or kilometer).

and L = length of the wire (miles or kilometers).

$\lambda = \frac{L}{2}$ = semi-length of the wire (miles or kilometers).

r = linear resistance of the wire (ohms per mile or kilometer).
l = linear inductance of the wire (henrys per mile or kilometer).
g = linear leakance of the wire (mhos per mile or kilometer).
c = linear capacity of the wire (farads per mile or kilometer).
$\omega = 2\pi n$ = angular velocity of impressed frequency (radians/second).
n = impressed frequency (cycles/second).
$j = \sqrt{-1}$.

into two condensers. Such a Π may be called the *nominal* Π of the line wire. Corrections must be applied to the electrical constants of the nominal Π in order to compensate for lumpiness.[3] The corrected Π may be called the *equivalent* Π of the actual line wire. It can be shown that the equivalent Π is the complete substitute for, and counterpart of, the real line wire at the line terminals, and at all external points of the connected system, in the steady state, for any single impressed frequency. Internally, however, the conditions are not, in general, the same in the real line wire as in its equivalent Π. Oscillatory

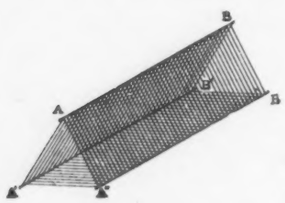


FIG. 3.—SET OF THREE-PHASE TRANSMISSION WIRES.

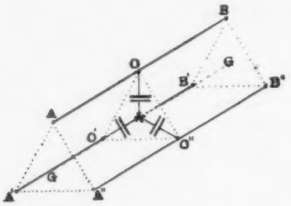


FIG. 4.—NOMINAL EQUIVALENT CIRCUIT OF THREE-PHASE SET OF WIRES. THREE EQUAL CONDENSERS CONNECTED IN STAR BETWEEN MID-LENGTH POINTS O, O′, O″.

disturbances, or unsteady conditions, in general, produce different conditions with the real line wire and with its equivalent Π, both internally and externally.

In some computations, or for some purposes, the equivalent *T* of a line is the more convenient substitute; while for other computations or purposes, the equivalent Π is the more convenient substitute. Being, however, identical substitutes for all external relations, the same results can be obtained with either equivalent.

It is the object of this paper to present the computed values of resistances, reactances, inductances and capacities both in the equivalent *T* and in the equivalent Π, of a particular type of transmission-line, for different frequencies such as might be expected to occur in practice.

The transmission line assumed in the computation has a length *L* of 250 km (155.34 statute miles), and consists of three No. 000 A. W. G. aerial copper wires 0.41 in. (1.041 cm) in diameter, supported symmetrically on pole insulators at a

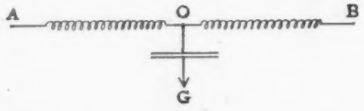


FIG. 5.—T-CONDUCTOR EQUIVALENT TO AN ALTERNATING-CURRENT TRANSMISSION WIRE.

uniform interaxial distance of 72 in. (193 cm). The following values of linear wire resistance, inductance and capacity have been taken as constant at all of the frequencies considered:[4]

$r = 0.206$	ohm/km	$= 0.33$	ohm/mile
$l = 1.222285$	millihenry/km	$= 1.967$	millihenry/mile
$c = 0.0094828$	microfarad/km	$= 0.01526$	microfarad/mile

The linear leakance of the wires is taken as negligible.

With the above values, the following constants are involved in the total resistances, inductances and capacities both of the nominal *T* and the nominal Π, for each wire referred to zero potential return:

Resistance, 51.5 ohms. Inductance, 0.30557 henry. Capacity, 2.3707 microfarads.

It is assumed that this transmission line is operated three-phase, at an impressed fundamental frequency of 25 cycles per second, or at an impressed angular velocity of $\omega_1 = 157.08$ radians per second.

In practice, such a line might be operated at the sending end by an impressed effective e.m.f. between wires of from, say, 55 kv to 110 kv, corresponding to star voltages per wire of from 31.75 kv to 63.5 kv to ground or zero potential. In order to generalize and simplify the matter, we may assume an impressed effective star voltage of unity, or 100 per cent, at the sending end of each wire, so that the results will apply equally to any desired magnitude of impressed e.m.f.

It is further supposed that the impressed voltage, of fundamental frequencies 25 ∼, is accompanied by harmonics of odd order. It is known that, in three-phase systems, neither triple-frequency nor 3*n*-frequency harmonics can occur on the transmission lines, to any appreciable extent, in the steady state, being absorbed by the terminal apparatus, whether the lines are connected in star or in delta. The harmonics which may be expected to occur will be of 5, 7 and 11 times the fundamental frequency, as far as the 11th order inclusive. The e.m.f. of these various possible harmonics should not be large in well-constructed transmission alternators; but each may, in turn, be considered as unity, or 100 per cent, for convenience of reference. The length of line selected happens to be resonant to the frequency of 293.424 cycles per second, which is 11.737 times the fundamental frequency of 25 ∼. This first resonant frequency is, therefore, not an exact multiple of the fundamental frequency, but approximates to its 11th harmonic. It is evident, however, that if the alternator supplying this transmission system were driven at about 7 per cent above normal speed, the 11th-harmonic frequency would coincide with this resonant frequency of the line. The equivalent *T* and Π have, therefore, been computed for the fundamental, 5th, 7th and 11.737th, or resonant, frequency multiples. The results appear in the following tables:

TABLE I

EQUIVALENT T OF EACH LINE WIRE AT DIFFERENT FREQUENCIES

Frequency Cycles/ Seconds	Total Wire Impedance Ohms	Wire Inductance Henrys	Leak Impedance Ohms	Capacity Micro-farads
0	$51.50 + j0$	0.30557	∝	2 3707
25	$51.669 + j\ 47.952$	0.30527	$-\ 8.649 - j2693.3$	2.3637
125	$55.594 + j248.88$	0.31688	$-\ 9.545 - j\ 579.15$	2.1985
175	$60.065 + j362.124$	0.32934	$-10.610 - j\ 445.75$	2.0403
293.42	$84.114 + j714.594$	0.38760	$-16.351 - j\ 358.48$	1.5131

TABLE II

EQUIVALENT Π OF EACH LINE WIRE AT DIFFERENT FREQUENCIES

Frequency Cycles/ Seconds	Total Wire Impedance Ohms	Wire Inductance Henrys	Impedance of Each Leak Ohms	Total Capacity Micro-farads
0	$51.50 + j0$	0.30557	∝	2.3707
25	$51.21 + j\ 48.01$	0.30564	$9.726 - j5362.2$	2.3745
125	$44.077 + j223.285$	0.28430	$8.67 - j1033.86$	2.4631
175	$37.418 + j290.058$	0.26380	$8.87 - j\ 710.44$	2.5603
293.42	$16.435 + j360.313$	0.19544	$9.355 - j\ 359.65$	3.0163

The first line in each table corresponds to zero frequency, and contains the constants for the nominal *T* and nominal Π respectively. That is, the nominal *T* and nominal Π require no correction for frequency 0. As the frequency increases, the equivalent *T* wire-resistance and inductance increase, while the equivalent Π wire-resistance and inductance diminish. It is just the opposite as to the wire capacity, which as the frequency rises becomes greater in the equivalent Π and less in the equivalent *T*.

It is easy to see why the line is resonant at the last frequency in the tables (293.42 ∼), by an inspection, say, of the equivalent Π. The line wire has a positive, or inductive, reactance of 360 ohms and the leak at the far end has a negative, or capacity, reactance of nearly the same amount; so that with these two in series, the line behaves at the sending end almost like a simple ohmic resistance of 25.79 ohms to ground, except for the capacity in the leak at the sending end.

METHODS OF COMPUTING THE VOLTAGE AT THE DISTANT FREE END OF THE LINE.

Several approximate methods are used by engineers for computing the voltage at the distant end of a transmission line when the load is entirely removed, and when the voltage at

[3] The correct impedance of the reactance coil *AB* (Fig. 6) in the equivalent Π is $z_0 \sinh L\alpha$ ohms, and the correct impedance in each of the two condenser branches is $z_0/\tanh \lambda\alpha$ ohms, where the symbols have the same meanings as in the preceding foot-note.

[4] "The Inductance and Capacity of Suspended Wires," by E. J. Houston and A. E. Kennelly, *Electrical World*, Vol. XXIV, No. 1, p. 6, July 7, 1894.

the distant end is, in general, greater than the voltage impressed on the sending end of the line. These methods may be compared as follows:

(1) *Condenser Current in Nominal T.*

In this approximation, the nominal T of one line wire is first prepared as in Fig. 5. Let the vector impedance of each half of the choking coil AB be z' ohms; let Z' be the impedance of the condenser, and e the impressed star voltage at the sending end. Then the true charging current will be

$$i = \frac{e}{z' + Z'} \quad \text{amperes} \quad (1)$$

but z will usually be small compared with Z', so that, without large error

$$i' = \frac{e}{Z'} \quad \text{amperes} \quad (2)$$

The drop of pressure produced by this charging current in the reactance AO, Fig. 5, will be

$$e_1 = i'z' \quad \text{volts} \quad (3)$$

so that the voltage at the distant free end of the line is

$$e' = e - e_1$$
$$= e - e\frac{z'}{Z'} = e\left(\frac{Z' - z'}{Z'}\right) \quad \text{volts} \quad (4)$$

All of the above equations are vector equations. The error in them is partly that the T is only a nominal T, not corrected for lumpiness, and partly because of the disregard of the line impedance when determining the vector charging current i' in equation (2).

(2) *Vector Method on Nominal T.*

In this method, equation (1) is used for determining the charging current, instead of the simpler equation (2). The drop of pressure in the reactance AO is

$$e_1 = iz' \quad \text{volts} \quad (5)$$

and the voltage to neutral point at the far end of the line is

$$e' = e - e_1$$
$$= e - e\left(\frac{z'}{Z' + z'}\right) \quad \text{volts}$$
$$= e\left(\frac{Z'}{Z' + z'}\right) \quad " \quad (6)$$

The only error in this method is in the use of the nominal T of the line-wire instead of the corrected or equivalent T.

(3) *Hyperbolic Method.*

In this method no reference is made to an equivalent T, but the correct hyperbolic formula is used[a]

$$e' = \frac{e}{\cosh La} \quad \text{volts} \quad (7)$$

where a is the attenuation constant of the line. This method is believed to be fundamentally correct.

(4) *Vector Method on Equivalent T.*

This is the same as method (2) except that the equivalent T is substituted for the nominal T. Its error has thus disappeared.

(5) *Vector Method on Equivalent* II.

In Fig. 6, let z'' be the vector impedance of the line-wire reactance coil AB, and Z'' the vector impedance of each of the two terminal condensers. Then with the far end free, the voltage there will be

$$e' = e\frac{Z''}{Z'' + z''} \quad \text{volts} \quad (8)$$

This method should also give arithmetically correct results. Summing up, therefore, methods (3), (4) and (5) should, and do, give the same arithmetically correct results, method (2) should give the next best results, while method (1) should be the least reliable, or should contain the largest error.

[a] "On the Fall of Pressure in Long-Distance Alternating Conductors," by A. E. Kennelly, *Electrical World*, Vol. XXIII, No. 1, p. 17, January, 1894. "Resonance in Alternating-Current Lines," by E. J. Houston and A. E. Kennelly, *Trans.* Am. Inst. Elec. Eng., Vol. XII, pp. 133-157, April 17, 1895.

The following table gives the voltages at the distant free end of the three-phase transmission line above considered, computed for the frequencies already discussed, and assuming the impressed voltage at the sending end to be 1.0 in each case:

TABLE III

VOLTAGE AT FAR FREE END WITH VOLTAGE 1.0 IMPRESSED AT THE SENDING END OF THE WIRE 250 KILOMETERS LONG

Frequency	(1) Condenser Method. Volts	(2) Vector Method Nominal T. Volts	(3) (4) and (5) Hyperbolic and Vector Methods Equivalent T and II. Volts
25	$1.00898\angle 0°.33'$	$1.00902\ \angle 0°.33'$	$1.00897\angle 0°.33'$
125	$1.2244\ \angle 2°.15'$	$1.2853\ \angle 3°.32'$	$1.2728\ \angle 3°.15'$
175	$1.4393\ \angle 2°.40'$	$1.7666\ \angle 6°.49'$	$1.6800\ \angle 5°.34'$
293.42	$2.234\ \angle 2°.53'$	$3.890\ \angle 154°.02'$	$13.945\ \angle 90°$

The first line of the above table shows that the rise of voltage at the distant free end of the line here considered is less than 1 per cent, at the fundamental frequency of 25 ~. Moreover, all of the five different methods give, for practical purposes, the same result. That is, it is quite sufficient, for ordinary purposes, to use the nominal T to represent the line and to take the condenser as charged to full initial potential. In other words, it seems entirely justifiable at this frequency to ignore the refinements of hyperbolic analysis in the fundamental method No. (3), or the refinements which correct the nominal T, or nominal II, for lumpiness. The voltage at the distant end of the line can be obtained closely enough for all practical purposes by the approximate method (1), even with lines 250 km (155 miles) in length, worked at the frequency of 25 ~, in the steady state.

At the fifth-frequency harmonic (125 ~), the table shows that the first approximation method (1) gives a distant-end voltage within 4 per cent of the arithmetically correct value, and the second approximation method (2) gives a value within about 1 per cent of the same result.

At the seventh-frequency harmonic (175 ~), it may be

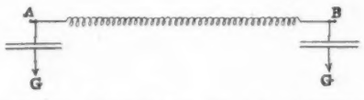


FIG. 6.—π-CONDUCTOR EQUIVALENT TO AN ALTERNATING-CURRENT TRANSMISSION WIRE.

seen that the first approximation method (1) gives a voltage 14 per cent low, and the second approximation method (2) gives a voltage about 5 per cent high, the arithmetically correct value being 1.680 lagging 5°.34' behind the impressed voltage at the sending end. This latter result is reached by each and all of the alternative correct methods (3), (4) and (5).

At the resonant frequency of 293.42 ~ the approximate methods (1) and (2) are entirely inadequate, and give misleading results; whereas all of the three correct methods give a voltage of 13.945 lagging 90 deg. behind the impressed voltage at the sending end. Consequently, whatever voltage is applied at the sending end would be multiplied nearly 14-fold at the distant end freed, or without load. For instance, 100 volts between wires at the generator end should produce 1394.5 volts between any pair of the free distant ends. It is proper to point out that no such large resonant rise of potential has yet been reported on any actual line, and, until verified, this deduction must be regarded merely as a theoretical prediction. Lines of 250 km in length are not likely to be deliberately operated at nearly 300 cycles per second. Even if operated steadily at such a frequency, considered as an accidental harmonic to the fundamental working frequency, such a line would probably be loaded at the distant end, and if such loads are applied to the equivalent T or equivalent II of the line, it will be readily seen that the rise of voltage is markedly reduced, the balance between the positive reactance of the line and the negative reactance of the leak having been upset by the application of load. Similar considerations apply if a load be placed on the line at some intermediate point along it. In such a case, however, the line must be regarded as divided into two portions each of which is capable of being replaced by an equivalent T or equivalent

II. Again the magnitude of the 11th-frequency harmonic voltage will probably be very small with respect to the magnitude of the fundamental frequency voltage, and will be added vectorially at right angles to the latter. A 5-per-cent resonant frequency component, in the case of the line here considered, would produce a voltage of 70 per cent at the far end, and add only 22 per cent to the total voltage there, as indicated by voltmeter.

If actual experiment should show that the resonant rise in voltage at the far free end of such a line is not so great as that set forth above, the discrepancy is likely to be found not in the methods of computation here indicated, but in the existence of dielectric or insulator leakage ordinarily regarded as negligible.

Conclusions.

Any transmission line, single-phase or multiphase, may be analyzed into single wires, each worked to zero potential and capable of being represented as a nominal T, or nominal Π. At the fundamental frequencies employed in transmission, no modification of these equivalent circuits is required, for ordinary engineering purposes, up to overhead lengths of 250 km, at least.

For higher harmonic frequencies, and especially for frequencies at or near resonance, it becomes necessary to substitute the equivalent T or Π for the nominal T or Π of the line wires.

The equivalent T or Π is the complete external substitute for any single length of uniform line wire operated at any single alternating-current frequency in the steady state.

Representation of Synchronous Converter Phenomena.

By Olin J. Ferguson.

In this discussion, the following symbols will be used:

n = number of rings of synchronous converter.
I_0 = direct current delivered.
E_0 = commutator voltage, line.
I_1 = maximum value of sine-wave current in an armature coil.
I_n = effective value of I_1.
E_1 = maximum voltage between adjacent collector rings.
E_n = effective value of E_1.

The e.m.f. ratios of a synchronous converter are graphically indicated by the vector diagram, Fig. 1.

$O E_0$ is the value of commutator voltage.

$$O E_2 = \frac{O E_0}{\sqrt{2}}$$

For an n-ring converter, lay off the angle $\frac{\pi}{n}$, measuring from the initial line $O A$. Then $O E_1$ is maximum alternating voltage, E_1, and $O E_n$ is the effective alternating E_n.

It is seen at once that $E_n = \frac{E_0}{\sqrt{2}} \sin \frac{\pi}{n}$.

For ordinary practice, the values of $\sin \frac{\pi}{n}$ are easily remembered.

Current ratios are calculable from these relations, taken with one further assumption that the output equals the input.

$$n I_n E_n = I_0 E_0.$$

Whence,

$$I_n = \frac{I_0 \sqrt{2}}{n \sin \frac{\pi}{n}}$$

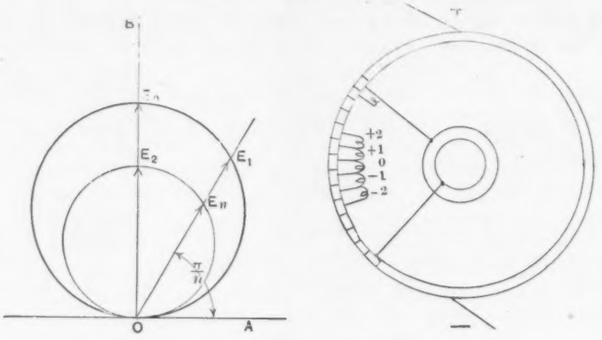
$$I_1 = \frac{2 I_0}{n \sin \frac{\pi}{n}}$$

The alternating-current sine wave is

$$i_n = I_1 \sin \omega.$$

The different coils in a phase winding (that is, the coils between adjacent collector rings) may be numbered from zero at the center of the winding outward in each direction, as indicated in Fig. 2.

If that half of the direct current passing through one side of the armature winding is added to the sine wave of the alternating current there is obtained the displaced sine wave $i_n + \frac{I_0}{2}$



FIGS. 1 AND 2.—VOLTAGES AND COILS OF CONVERTERS.

shown in Fig. 3. Upon the other side of the armature winding there will be $i_n - \frac{I_0}{2}$, or the lower displaced sine wave. Actual current conditions in any one coil are thus represented by portions of both of these displaced waves used successively as the coil passes under a brush on the commutator. For example, the direct current in the coil at the center of the winding reverses at the instant the alternating current is zero (with unity power factor), so that there is obtained the current wave $a\ o\ z\ o'\ a'\ a''\ o''\ z''\ o'''$ . . . A coil later in the reversal in the same phase will have cross-overs from sine wave to sine wave at $^+1$, $^+1'$, $^+1''$ . . . or at $^+4$, $^+4'$, $^+4''$ . . . according to the amount of displacement.

In a coil preceding the center coil displacement is in the opposite direction and, hence, the reversals occur at $^-1$, $^-1'$, $^-1''$, . . . or $^-4$, $^-4'$, $^-4''$, ...

With a power factor equal to 1, the displacement of the reversals to z, z', z'' . . . cannot occur in any machine except the two-ring converter and even then one must consider as negligible the width of brush, width of commutator, bar, etc.

Fig. 3 represents, to scale, the conditions for the two-ring machine. Fig. 4 similarly shows the limits and the magnitudes for the three-ring converter.

In order to individualize the currents in successive coils, as is ordinarily done, Figs. 5 and 6 are taken from Figs. 3 and 4, respectively. In Fig. 3, curve O shows the current in the center coil of the two-ring machine. Curve z is for the end coil. Between $^+4$ and z several curves are not shown. In Fig. 6 curve $^+5$ indicates the current in the end coil of the phase-winding of the three-ring machine.

The heating in any coil would be represented by the curve obtained by squaring the ordinates of the current curve for

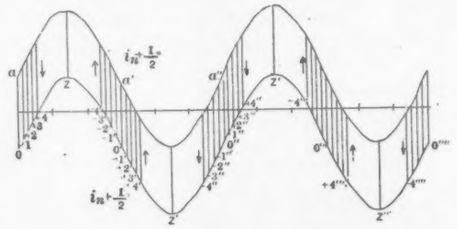


FIG. 3.—CURRENT IN A TWO-RING CONVERTER.

that coil. There is, however, a more striking means of showing this, by the use of polar co-ordinates and enclosed areas.

In Fig. 7 the sine wave of current is the circle $O P Q$. If the vector generating this circle is lengthened by the addition of $\frac{I_0}{2}$, the curve traced is the limaçon. A curve of the same type

results from subtracting $\frac{I_0}{2}$. A coil displaced from the center of the phase by an angle ω will have a current cycle *O A B P C D O*, first in a positive sense, then in a negative sense.

As the area enclosed by the current curve varies as the square of the current vector, this area represents the heating

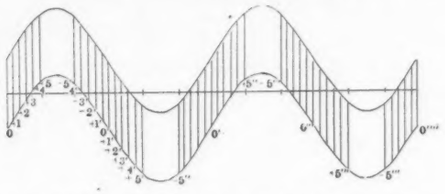
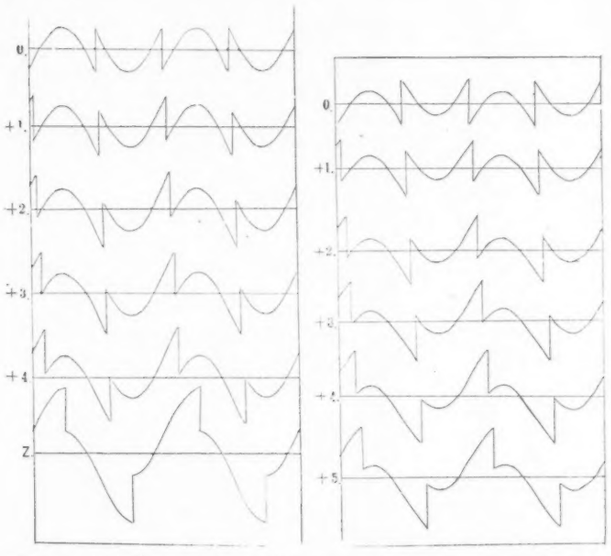


FIG. 4.—CURRENT IN A THREE-RING CONVERTER.

in the coil. A coil with a lesser displacement will have a current curve enclosing less area—meaning less heating.

In Fig. 8 is shown the comparative heating of coils displaced from the center of the phase winding of a two-ring machine by angles of 0, 15, 30, 45, 60 and 90 deg.

In Fig. 9 (drawn to the same scale as Fig. 8) the direct current is of the same magnitude, but the maximum value of the alternating current is less, because it is for a three-ring machine. Hence, both the inner and the outer loops of the limaçon shrink, and the areas are less than for coils having the same displacement in a two-ring machine. A 60-deg. displacement is the greatest possible with three rings and unity power factor.



FIGS. 5 AND 6.—CURRENT WAVES OF TWO-RING AND THREE-RING CONVERTERS.

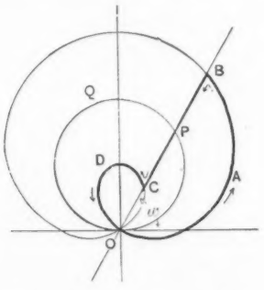


FIG. 7.—HEATING IN A REAR-END COIL.

Figs. 10 and 11 similarly represent, to scale, the heating for coils of four-ring and six-ring machines. The one is limited by a 45-deg. displacement, the other by a 30-deg. displacement.

The area enclosed by one of these curves is

$$\int_{\omega-\pi}^{\omega} i^2\,d\Theta = \int_{\omega-\pi}^{\omega} \left(I_1 \sin\Theta + \frac{I_0}{2}\right)^2 d\Theta$$

The ratio of this area to $\int_{\omega-\pi}^{\omega} d\Theta$ gives the square of the effective current. That is:

$$\frac{\int_{\omega-\pi}^{\omega} i^2\,d\Theta}{\int_{\omega-\pi}^{\omega} d\Theta} = \text{square of effective current} = h.$$

$$h = \frac{I_1^2}{2} - \frac{2}{\pi}\, I_1 I_0 \cos\omega + \frac{I_0^2}{4}$$

This is a measure of the heat developed in one coil at a space angle ω from the center of the phase winding.

$$\frac{\int_0^{\frac{\pi}{n}} h\,d\omega}{\int_0^{\frac{\pi}{n}} d\omega} = \text{average heating of these coils from the center of the phase winding to end.}$$

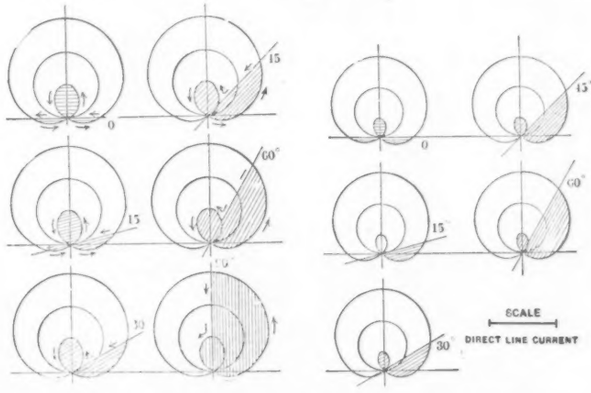
Calling this average H,

$$H = \frac{I_1^2}{2} - \frac{2n}{\pi^2} I_1 I_0 \sin\frac{\pi}{n} + \frac{I_0^2}{4}$$

$$= \frac{I_0^2}{4}\left(\frac{8}{n^2 \sin^2\frac{\pi}{n}} - .6211\right)$$

But, the rating is inversely proportional to the square root of the heating, therefore, the rating $= \frac{1}{\sqrt{H}}$

Calculated thus upon the impracticable basis of equivalent heating, the ratings compared to the direct-current rating as unity are as found in the first row of Table I.



FIGS. 8 AND 9.—HEATING IN TWO-RING AND THREE-RING CONVERTERS.

For a power factor of cos θ,

$$I_1 = \frac{2 I_0}{n \sin\frac{\pi}{n}\cos\theta}$$

that is, a larger maximum value of alternating current. Hence, the circles in the polar diagrams will be enlarged.

The expression for the square of the effective current in any coil will remain unchanged in form.

$$h = \frac{I_1^2}{2} - \frac{2}{\pi} I_1 I_0 \cos\omega + \frac{I_0^2}{4}$$

Fig. 12 shows the current cycle and the heating for a three-ring machine for individual coils at 0 deg., 30 deg., and 60 deg. from the center coil.

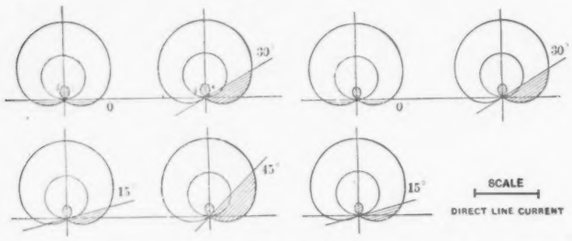
The limits of the second integration becomes $-\frac{\pi}{n} - \theta$ to $\frac{\pi}{n} - \theta$ for a whole phase.

$$\therefore H = \frac{\left[\frac{I_1^2}{2}\omega - \frac{2}{\pi} I_1 I_0 \sin \omega + \frac{I_0^2}{4}\omega\right]_{\frac{\pi}{n}-\theta}^{\frac{\pi}{n}-\theta}}{[\omega]_{\frac{\pi}{n}-\theta}^{\frac{\pi}{n}-\theta}}$$

$$= \frac{I_1^2}{2} - \frac{2n}{\pi^2} I_1 I_0 \sin \frac{\pi}{n} \cos\theta + \frac{I_0^2}{4}$$

$$= \frac{I_0^2}{4}\left(\frac{8}{n^2 \sin^2 \frac{\pi}{n} \cos^2\theta} - .6211\right)$$

From this expression is calculated the table of converter ratings at various power factors (Table I). Similarly, the



FIGS. 10 AND 11.—HEATING IN A FOUR-RING AND IN A SIX-RING CONVERTER.

added data of the power factor at which each machine may run with an output equal to its possible direct-current rating.

This table of ratings, based upon equivalent average heating of the entire phase, is, of course, wholly impracticable. So, also, from the standpoint of economy in construction would be the other extreme of basing the calculations upon the maximum heating.

In a further table the writer has assumed as a basis of comparison the average heating over that quarter of the phase winding at the end, where the heating is greatest.

With a lagging current this will be the end commutating first.

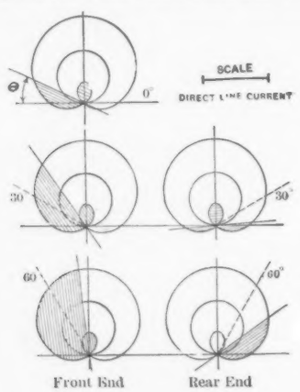


FIG. 12.—HEATING IN A THREE-RING CONVERTER. ANGLE OF LAG 25 DEG.

If x represents the percentage of the half phase winding to be used, the limits of integration for average heating becomes $\frac{x\pi}{n} - \theta$ to $\frac{\pi}{n} - \theta$. Hence, the average heating at power factor $= \cos\theta$ is

$$H_x = \frac{I_0^2}{4}\left\{\frac{8}{n^2 \sin^2\frac{\pi}{n}\cos^2\theta} - \frac{16}{x\pi^2}\left[1 - \frac{\sin\frac{(1-x)\pi}{n}}{\sin\frac{\pi}{n}} - \tan\theta\left(\cos\frac{\pi}{n} - \frac{\cos\frac{(1-x)\pi}{n}}{\sin\frac{\pi}{n}}\right)\right] + 1\right\}$$

For the mean for one-quarter of a phase winding the value of x is 0.5.

Table II gives these results for various power factors in terms of comparative heating as well as the results obtained by using the quarter of the phase winding at the cooler end. Table III shows the same in terms of ratings. Fig. 13 contrasts these results for a six-ring machine.

One may, upon the other hand, calculate the average heating for any percentage of the half coil.

Tables IV and V represent the conditions when $n = 6$ and x

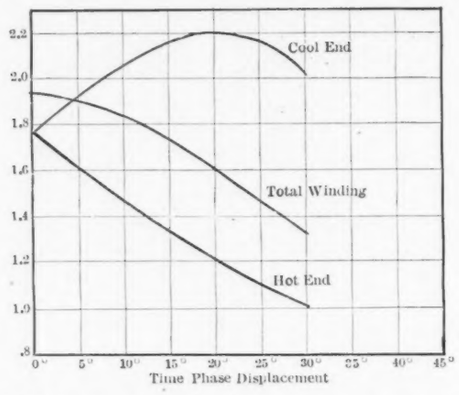


FIG. 13.—RATING OF A SIX-RING CONVERTER. FROM TABLES I AND III.

is varied from 0.1 to 1.0. As has already been noted, the heating in the front end of the phase winding with lagging current is greater. Based upon the fractional part x at this extreme, the mean heating will be much higher than it will be for the same limits at the rear end of the phase winding. For the sake of comparison both values are given and curves are plotted therefrom.

In Fig. 14 the abscissæ represent the value of x measured

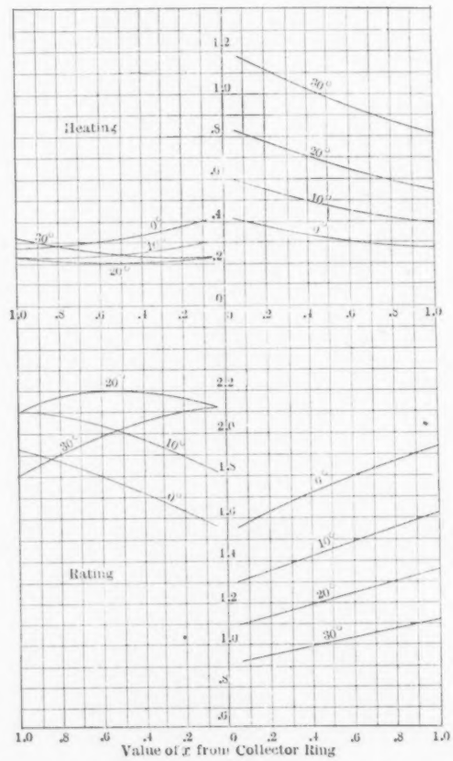


FIG. 14.—SIX-RING CONVERTER BASED UPON HEATING IN CERTAIN PARTS OF PHASE WINDINGS.

in each direction from the slip-ring, over which the heating is averaged—the right-hand side being for the front end of the coil with lagging current (rear end with leading current), and the left-hand being for the rear end of the coil with lagging

current (front end with leading current). The curves are calculated for angles of lag of 0 deg., 10 deg., 20 deg., 30 deg., as indicated.

The slip-ring position is at O. The middle coils of two successive phase windings are at $x = 1.0$ and 1.0. At any point of a curve, as 0.4, the ordinate represents the average heating of the portion of the phase winding between that point and the ring, or, in the lower curves, the rating for equivalent heating.

TABLE I.—CONVERTER RATINGS AT VARIOUS POWER FACTORS, BASED UPON THE AVERAGE HEATING.

Phase Displacement, Degrees.	P.F.	2-ring.	3-ring.	4-ring.	6-ring.	8-ring.	12-ring.	00-ring.
0	1.0000	.851	1.331	1.622	1.928	2.053	2.191	2.300
5	.9962	.846	1.320	1.636	1.904	2.028	2.155	2.259
10	.9848	.832	1.288	1.559	1.835	1.949	2.066	2.155
15	.9659	.809	1.241	1.486	1.728	1.828	1.932	2.006
20	.9397	.784	1.173	1.411	1.611	1.688	1.773	1.836
25	.9063	.742	1.102	1.291	1.471	1.538	1.602	1.655
30	.8660	.698	1.020	1.182	1.328	1.380	1.434	1.474
45	.7071	.543	.756	.851	.932	.956	.982	1.000
60	.5000	.368	.493	.543	.583	.596	.609	.617
Power factor for unity rating.		.856	.785	.739	.728	.7165		.707

TABLE II.—AVERAGE HEATING OVER ONE-QUARTER OF WINDING.

Phase Displacement.	Power factor.	Two-ring. Hot.	Two-ring. Cool.	Three-ring. Hot.	Three-ring. Cool.	Four-ring. Hot.	Four-ring. Cool.	Six-ring. Hot.	Six-ring. Cool.
0°	1.0000	2.050	2.050	.814	.814	.511	.511	.325	.325
5°	.9962	2.265	1.865	.942	.702	.605	.431	.388	.274
10°	.9848	2.516	1.708	1.092	.608	.716	.386	.477	.249
15°	.9659	2.811	1.585	1.268	.532	.849	.317	.562	.216
20°	.9397	3.152	1.484	1.470	.472	1.005	.283	.679	.207
25°	.9063	3.555	1.419	1.711	.431	1.192	.266	.819	.215
30°	.8660	4.037	1.397	2.001	.415	1.414	.274	.995	.247

TABLE III.—RATINGS, BASED UPON TABLE II.

Phase Displacement.	Power factor.	Two-ring. Hot.	Two-ring. Cool.	Three-ring. Hot.	Three-ring. Cool.	Four-ring. Hot.	Four-ring. Cool.	Six-ring. Hot.	Six-ring. Cool.
0°	1.0000	.699	.699	1.109	1.109	1.399	1.399	1.754	1.754
5°	.9962	.665	.732	1.030	1.192	1.286	1.523	1.607	1.910
10°	.9848	.631	.765	.957	1.282	1.182	1.610	1.448	2.003
15°	.9659	.596	.795	.888	1.371	1.086	1.777	1.334	2.155
20°	.9397	.564	.822	.825	1.455	.998	1.830	1.213	2.198
25°	.9063	.531	.840	.765	1.523	.917	1.940	1.104	2.160
30°	.8660	.498	.847	.707	1.552	.841	1.910	1.003	2.013

TABLE IV.—AVERAGE HEATING OVER X WITH DIFFERENT ANGLES OF PHASE DISPLACEMENT.

X	30°	20°	10°	0°	10°	20°	30°
.1	.223	.221	.294	.398	.579	.811	1.159
.2	.225	.214	.279	.377	.551	.776	1.115
.3	.229	.210	.268	.358	.525	.743	1.073
.5	.245	.207	.249	.326	.478	.679	.993
.7	.262	.208	.234	.296	.434	.621	.917
.8	.276	.213	.231	.285	.416	.593	.880
1.0	.310	.228	.229	.268	.383	.544	.812

TABLE V.—RATINGS, BASED UPON TABLE IV.

X	30°	20°	10°	0°	10°	20°	30°
.1	2.120	2.128	1.848	1.580	1.314	1.111	.929
.2	2.110	2.163	1.891	1.630	1.347	1.136	.947
.3	2.090	2.182	1.933	1.671	1.380	1.160	.966
.5	2.020	2.198	2.003	1.750	1.448	1.213	1.003
.7	1.955	2.195	2.066	1.840	1.517	1.270	1.045
.8	1.902	2.168	2.080	1.874	1.551	1.298	1.067
1.0	1.798	2.097	2.088	1.931	1.618	1.357	1.110

Graphical Diagram for Power in an Alternating-Current Circuit.

BY J. IRVING BREWER.

It is a well-known fact that in a single-phase circuit where the curves of pressure and current are sinusoidal, the power fluctuates at twice the circuit frequency, and is negative during a portion of each half-cycle except when the power factor is unity. The mean value of the power in such a circuit is represented by the expression $P = E I \cos \Theta$, where E and I are mean effective values of volts and amperes, and Θ is the angle of phase displacement between them. The value of the power at any instant is, of course, equal to the product of the volts and amperes at that instant. This value of the instantaneous power may be shown by a mathematical development to take the form

$$P' = E I \cos \Theta + E I \sin (2x - [90° + \Theta])$$

where x represents the angle through which the pressure has passed from its zero value. This expression for the instantaneous power shows that the power curve is sinusoidal and that it may, therefore, be constructed by the projection of points of a circle.

Since E and I are the effective values of pressure and current, they are such as are indicated on the voltmeter and ammeter; and the corresponding maximum values, E_m and I_m, may, of course, easily be calculated, being $\sqrt{2}E$ and $\sqrt{2}I$.

Reference is now made to Figs. 1 and 1a. Let the lines $(a\,b)$ and $(c\,f)$ intersecting at g be the horizontal and vertical axes, and let the pressure and current vectors E_m and I_m rotate in a clockwise direction about the point g, as indicated in Fig. 1. The two circles on the point g, as center in Fig. 1, represent this rotation and the vectors are supposed to begin rotation with the E_m vector at the point marked o, to the left of g. These vectors are laid out with the phase angle Θ between them. The circles are divided into 24 points, 0, 1, 2, 3, etc., and these points projected across on the corresponding verticals, 0, 1, 2, 3, in Fig. 1a, give the pressure and current curves marked E and I in Fig. 1a. After having laid out the pressure and current curves thus, the ordinates of the power curve may, of course, be found by scaling the corresponding ordinates of the pressure and current curves and taking their product. The power curve may, however, be laid out graphically as follows: Through g draw the line $(g\,h)$ equal in length to twice the produce of E and I, or which is the same thing equal to the product of E_m and I_m, and let $(g\,h)$ make an angle with the line $(c\,f)$ equal to the phase angle Θ. Now let l be the mid-point of the line $(g\,h)$; then the horizontal line $(k\,m)$ drawn through l is the axis of the sinusoidal power curve. Moreover, the distance $(g\,w)$ between the line $(a\,b)$ and the line $(k\,m)$ is equal to the average power; this fact will be apparent at once because the line $(g\,l)$ is equal to $E\,I$, which relation at once gives the distance $(g\,w)$ as equal to $E\,I \cos \Theta$. If now a circle be constructed on the line $(g\,h)$ as diameter, the power curve may be constructed graphically by projecting the proper points of this circle. This circle may be called the power circle, and its radius-arm P, swinging about l as center, may be called the power vector.

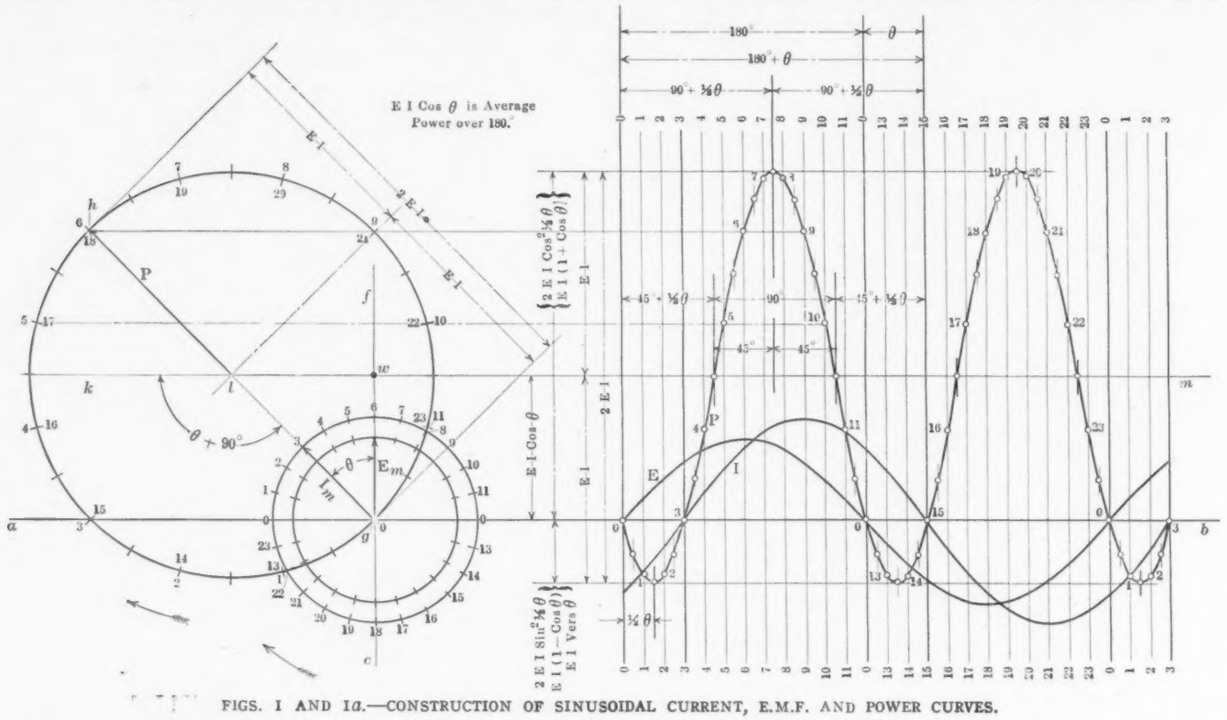
From the expression given earlier for the value of the instantaneous power P', it is clear that at the start, when x is zero, the pressure is zero and consequently the power will be zero. In which case it is seen that the power vector must start at an angle $(90° + \Theta)$ back from the horizontal, or must start at the point g, and rotate in the same direction as the pressure and current vectors. The power circle is divided into half as many points as the pressure and current circles, and the points 0, 1, 2, 3, etc., of the power circle projected across on the corresponding verticals 0, 1, 2, 3, etc., of Fig. 1a give the power curve marked P in Fig. 1a. It is to be noted that the power vector rotates twice around its circle while the pressure and current vectors rotate once. The total amplitude of the power wave is shown to be $2\,E\,I$, or $E_m\,I_m$, which is, of course, the same as the diameter of the power circle.

It is to be observed that if the phase angle Θ varies, the line $(g\,h)$, on which the power circle is described as a diameter, will swing about the point g as center and so also will the center l of the power circle swing about g. This is such that for a small phase angle Θ the power circle will occupy a position having its diameter $(g\,h)$ near the vertical, and for a phase angle Θ of nearly 90 deg. the power circle will occupy a position having its diameter $(g\,h)$ nearly horizontal. As the phase angle Θ increases, the axis $(k\,m)$ of the power curve will approach the axis $(a\,b)$, which is in accordance with the known fact that the average power will decrease; also as the phase angle Θ decreases the average power is shown to increase, which is again in accordance with the known fact. In all cases, independent of the value of the phase angle Θ, the power vector begins its rotation from the point g.

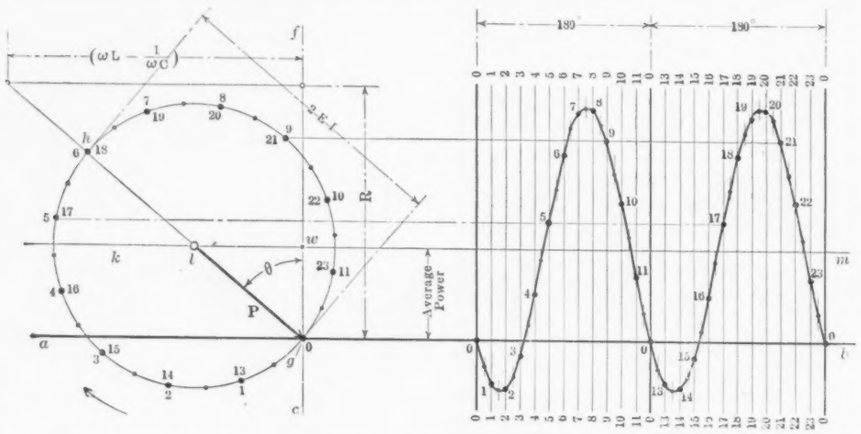
The figure given shows a phase angle of lag, but the conditions applying to an angle of lag apply equally well to an angle of lead, since the pressure curve and the current curve are of the same character, and all that is necessary to change from the condition of lag to lead is to interchange the names of the pressure and current curves.

It is to be observed that by means of the foregoing diagram the power curve may be constructed without laying out the pressure and current curves, and may be constructed from the

data merely of the effective pressure, the effective current, and the phase angle. As a simple instance, assume one phase of a generator to impress a harmonic e.m.f. having an effective value of E of 200 volts at a frequency f of 60 cycles on a circuit having a resistance R of 80 ohms, a series inductance L of 0.6 henry, and a series capacity C of 0.00002 farad. The calculations show the reactance of this circuit to be 93.6 ohms, and the effective current to be 1.625 amp. The instructions for the construction of Figs. 2 and 2a are as follows:



FIGS. 1 AND 1a.—CONSTRUCTION OF SINUSOIDAL CURRENT, E.M.F. AND POWER CURVES.



FIGS. 2 AND 2a.—POWER CURVE FOR CIRCUIT HAVING SERIES RESISTANCE AND REACTANCE.

Draw the horizontal axis $(a\,b)$ and the vertical axis $(c\,f)$ intersecting at g, then draw $(g\,h)$ making an angle with $(c\,f)$ equal to the phase angle Θ; the angle Θ may first be calculated and then laid out; in this case $49° - 28'$; or the line $(g\,h)$ may be located as follows: To some convenient scale lay out on the line $(c\,f)$ a distance R corresponding to the resistance, in this case 80 ohms, and then lay out the distance marked $(\omega L - [1 \div \omega c])$ corresponding to the reactance, in this case 93.6 ohms. These distances determine the angle Θ. The power circle is constructed with the diameter $(g\,h)$ equal to $2\,E\,I$, in this case $2 \times 200 \times 1.625 = 650$. This circle may be drawn to any convenient scale whatever. The power vector P starts at the point g and rotates clockwise through two complete rotations to give the power curve for one circuit cycle. The power curve is shown in Fig. 2a. That part of the curve above $(a\,b)$ is positive power and that part below $(a\,b)$ is negative power; $(k\,m)$ is the axis of the power curve and the distance $(g\,w)$ of the line $(k\,m)$ above the line $(a\,b)$ is the average power. After having thus constructed the power curve, if it is desired to show the pressure and current curves in their proper relation on the same diagram, this can readily be done by the process discussed in Figs. 1 and 1a.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Water Condensing Plant, Sioux City, Iowa.

The Sioux City Gas & Electric Company recently completed the work of changing its power plant from one filled with small belt-driven units to one containing only direct-connected and large belt-driven units.

The condensing water features of this plant are interesting. The plant is not located on the river, but obtains its condensing water from wells. These wells are 400 ft. deep, but the suction lift of the condensers is only from 0 to 10 ft. To supplement the water obtained from the wells, during the peak load, water for condensing purposes is taken from a large gas holder on the premises. This is 130 ft. in diameter, and con-

densing water can be taken from it during the peak without lowering the water seal enough to be objectionable. The water in this gas holder is 7 ft. above the condensers, so that it flows by gravity to the condensers. The condenser discharge is regularly fed into a smaller gas holder on the premises.

Method of Checking Lamp Outages and Careless Trimming.

In nearly all large cities contracting for public lighting, the outage of lamps is reported daily by the police on blanks prepared for the purpose and the electric light company is notified by telephone so that repairs can be made. In Rochester, N. Y., the electric light company is penalized for all outages reported by the police. The contract with the city calls for 4000 hours' yearly burning of arc lamps. If a lamp is out a rebate equal to the charge made is deducted, and if the lamp remains unlighted for five hours it is equivalent to a night's outage. If the lamp is out the second night a deduction equal to twice the rate charged is made, and if the lamp is unlighted for three successive nights the deduction made is equal to five times the rate charged. The Rochester Railway & Light Company has therefore organized a patrol service to look after and report defects of this kind, with the result that in 1908 the outages were less than 1/10 of 1 per cent of the total hours' burning. Not a little of this good showing is attributed to the system of checking outages by means of a map and pegs.

Up to a year ago it was customary to report all outages to the line department; but it seems that figures did not impress themselves on the minds of the linemen. A map of the city was therefore brought into use, and as reports came in to the main office of defects they were sent to the line department as usual, and in addition at the end of the month the map was pegged up and sent first to the officers of the company and then to the line department. In pegging this map of outages, five kinds of pegs are used. A red peg indicates a lamp out one night, a blue peg two nights, a yellow peg three nights in succession, a plaid peg three nights not in succession and a tag shows that the entire circuit was out. The map appeals to the linemen as no figures can and shows at a glance where the outages are most frequent and on what circuits. By this means defects in lamps are checked as well as faulty circuits; but the chief use of the map is in detecting careless trimming, and for this purpose the scheme acts as a boomerang. Since the system was devised three trimmers were discharged because of slipshod work, and the efficiency of the trimming force has been raised considerably. A system of this kind can of course also be used to show the reliability of one lamp as compared with another, etc.; but for the purpose for which it was devised it has proved its worth many times over.

A Central Station with Its Peak Load in Summer.

One of the most remarkable central-station companies in the United States as regards the character of its load is the Norfolk Electric Light & Power Company, of Norfolk, Neb. Mr. E. A. Bullock, president and manager of this company, has accomplished with this little plant what practically every progressive central-station manager is striving to accomplish. He has succeeded in marketing electric power for various purposes in his community in such a way that the earnings for each month of the year are very nearly the same. He does not have the usual falling off of earnings during the summer with a large part of the plant investment lying idle.

Norfolk is a town of 4000 or 5000 inhabitants. The station capacity is something less than 200 kw, part being supplied by a small water power located at a mill and part by a steam plant. The water power is insufficient to carry the load most of the time, so that the steam plant has to be kept ready for operation at all times, and is actually operated most of the time.

The peak loads of the plant for the year occur on Tuesday afternoons in midsummer.

The December peak load caused by lighting is not quite as high as that caused by electric power and flatirons in midsummer. For example, the peak load last summer amounted to 65 amp at 2300 volts, or 149 kv-amp. The winter peak previous to the holiday December evenings only reached 50 amp, or 115 kv-amp. These unusual conditions of load are brought about by the use of electric power for refrigerating purposes and city waterworks pumping, together with 200 electric irons connected. The refrigerating motors are, of course, used only in summer, while the motor used at the city waterworks for pumping has its heaviest load in summer.

Among the motors which have the most influence on summer load are the following: Forty-five hp in motors used in an ice factory, of which Mr. Bullock, president of the company, is part owner. There is also an installation of 35 hp in the establishment of a butter company, part of which is used for refrigeration, and operated only in summer. The waterworks motor is of 30 hp, and is run fully loaded only in summer, as explained in detail later. While the monthly output in kw-hours is greater in the summer than during the December peak load period, it is sold at a lower rate for power purposes, so that earnings are about the same for each month in the year.

The ice factory pays for power at the rate of $1.60 per ton of ice manufactured. The central station also furnishes steam for the re-boiler in the ice factory. The ice factory equipment consists of one 40-hp and one 5-hp, two-phase motor. A 4-hp motor in an ice cream factory also adds to the summer load.

A list of the motor installations connected for this company's lines shows 155 hp in Wagner single-phase motors and 45 hp in two-phase motors, a total of 200 hp. The only two-phase installation in the town is that at the ice factory, and the company regrets that this was not single phase, as a single-phase motor causes less disturbance of the voltage when motors are started than the two-phase.

WATERWORKS PUMPING CONTRACT.

The company furnishes the motor and power for pumping water for the city under a six-year contract. The method of arriving at the price for pumping, while in some respects unusual, is one which proved very convincing to the city as to the saving to be effected. The cost of coal maintenance of pumping plant, oil and supplies for the past eight years of steam operation of the city waterworks was obtained from the city records. This averaged $175 per month and did not include labor. The company agreed to pump city water at a flat rate of $175 per month, thus saving the labor which up to that time had amounted to $70 per month, and which was soon to be increased to $110 because of the necessity of having two men to operate two shifts instead of one man operating one shift as before.

The company furnishes the motor, which is placed at the waterworks and is belted to a Fairbanks-Morse duplex double-acting pump. The motor is a 30-hp Wagner single-phase. A single-phase motor was chosen here because it necessitated the running of only two wires from the central station to the pumping station and also because of the automatic character of its starting and the small voltage disturbance caused thereby. It is started and controlled entirely from the electric power plant about a half-mile distant.

This pump operates against 75-lb. pressure and pumps to a stand pipe, so that there is some water storage and the pump can be shut down during the company's peak load. This motor is fitted with four different sizes of pulleys, which are changed as the pumping requirements of the city change from season to season. It is intended to operate the motor steadily most of the time, with the exception of six hours per day. At the lowest speed of the pump (that is, with the smallest motor pulley) the pump will lift 250 gal. per minute, and at the highest speed 500 gal. per minute. It is found that the friction head with the duplex double-acting electric pump is about 10 ft.

less than it was with the steam pump, on account of the greater pulsations caused by the latter.

In order to protect the company so that it will get revenue for new water consumers, it is agreed between the city and the company that the city will take on no more flat-rate consumers, all consumers being placed on water meters. The company is to get 5 cents per 1000 gal. for all water metered to these new consumers. No record is kept of the gallons of water pumped per day under this contract. It is probable in a plant of this size, however, that it runs from 100,000 gal. per day up, the greatest demands, of course, coming in midsummer, making it a very desirable load for the central-station company.

The rates in Norfolk are based on 10 cents per kw-hour maximum, with a minimum bill of $1 per consumer in residences and 40 cents per 56-watt lamp in stores. There is no regular published schedule of rates, but discounts are given depending entirely on the number of hours' use per month of the connected load. The lowest rate is 3.5 cents. The company has 400 meter consumers and 50 flat-rate fans and small motors. Ceiling fans are rented for the season from June 1 to Oct. 1 at the rate of $12 for one fan and $20 for two.

The company has gross earnings in the neighborhood of $5 per capita of population. As might be expected from the peculiar year-around character of the company's load, the earnings per kilowatt of station capacity are far above those usual among central-station companies, being about $139 per kilowatt of capacity annually. This indicates that the company is making remarkably good use of the apparatus and investment which it has.

INTERIOR WIRING AND ILLUMINATION

Wiring for Alternating-Current Circuits.

The Code is specific in recommending that for alternating-current systems the two or more wires of a constant-potential circuit must be drawn in the same conduit. It is not often that a contractor seeks to go the Code one better by putting in an excess of conduit; but the following illustrates such a case and its results. A contractor who never installed an alternating-current job before received an order to wire 12 arc lamps in a department store. He somehow got the impression that alternating currents were very dangerous, and wishing to make a good and safe job, placed each of the wires in a separate iron pipe. The result of his misdirected efforts can be imagined. The conduit became hot and the drop in voltage excessive. He sought for leaks and short circuits in vain until informed that the wires should have been placed in a single conduit and that the drop was caused by induction caused by the presence of the iron wall around each wire and that the iron pipe was hot because the pipe formed a closed magnetic circuit about the wire within it, causing a loss by hysteresis. The contractor accepted the explanation on blind faith and tried the remedy with the result that the trouble disappeared and a well-meaning wireman was set right.

Illuminating Engineering vs. Common Sense.

By Basil G. Kodjbanoff.

An electrician is presumably a person who is familiar with the theory and practical application of electricity; at least, that is what the word would imply. But so great is the desire of people to describe their work or their profession by a high-sounding name, that "electrician" has in fact come to mean anything from an arc-lamp trimmer to an electric-bell hanger. To be sure, both of these are honest and honorable employments, but they do not call for a degree of technical knowledge and skill that justifies the assumption of a professional title. Within the past few years there has sprung up a class of workers who have taken upon themselves the privilege and prerogative of doctoring lights; but instead of assuming the doctor's degree, they have called themselves "illuminating engineers." Their chief vocation has been to persuade the luckless user of any particular method of lighting that the system was all wrong, and that the only sure way to illumination salvation was by subscribing to their particular creed. The articles of faith constituting their creeds vary according to their professional training and commercial sympathies. Some believe that the arc lamp is the only real means of grace, while others consider this rank heresy and base their hopes on incandescents—and so on through the rest of the list of illuminants; while a large number of them show the glory of their attainments by wearing a perpetual halo of prism glass.

Now, it is true that some of the old lighting installations were poor and inadequate in comparison with the best results obtainable to-day; but the fact must not be lost sight of that the past few years have developed remarkable improvements in light sources and in the apparatus for using them, which have been produced without the permission or assistance of the illuminating engineering cult. Suppose the illuminating engineer, properly so-called, had not appeared on the scene, would we not have the tungsten lamp, the flaming-arc lamp, the mercury-vapor lamp and the inverted gas burner just the same? Or again, would the illuminating engineers be willing to wager their professional standing on the ability of the people to pick out the installations that they have designed from among those that have been laid out by the architect or electrical engineer?

The properties of light may be made the basis for a great many mathematical calculations; but so may many other of the common phenomena with which we constantly have to deal. The amount of stress or tensile strength required in drawing corks from different kinds of bottles would afford material for an elaborate investigation and might be of some use in the theoretical designing of a corkscrew built on engineering principles; but most people will prefer to use the corkscrews that they have, or let the waiter pull the cork, according to the custom that has long prevailed. The "illuminating engineer" figures the intensity of illumination down to the third decimal place, in spite of the fact that the eye is accustomed to work through intensities ranging up to at least 100,000 times the minimum. When all his figuring has been done, are the results any better than would have been obtained by any good electrical engineer or architect who has had experience coupled with observational power?

Unquestionably the increased number of light-sources and accessories of to-day requires a more careful consideration, wider experience and more discriminating judgment in order to secure the best results, than was the case 10 or 20 years ago. "Practice makes perfect," and it is pretty safe to say at the present time that the best results in illumination will be obtained by those who have had the most practice in using and installing the different kinds of lights. A few weeks' or months' apprenticeship in the sales department of a manufacturing concern handling some particular light-source or accessory, is hardly a fair substitute for the years of school and practical training deemed necessary to equip one for the various engineering professions; yet there is nothing to prevent such an apprentice from hanging out his shingle as an "illuminating engineer" at the present time.

The "illuminating engineer" at first did most of his talking about efficiency and economy. Finding, however, that this did not suit all classes—that there were many people who, having the price, preferred a $50 suit of clothes to a $15 hand-me-down which might give even longer wear—they began to sing another song pitched to the key of "artistic harmony." What the architect has taken years of study and practice to acquire, they apparently have received by direct inspiration. "Efficacy" and "satisfaction" are two passwords that now hold place along with "economy" and "efficiency."

I do not wish to be understood, however, as maintaining that there is not sufficient material and field of operations for a science and art of illumination. Not only is the subject as a whole sufficiently comprehensive to afford ample opportunities for the specialist, but it is capable of being subdivided into departments, each of which is sufficiently large to constitute a specialty. In fact, it is the very extensiveness of the field that demands an unusually high degree of knowledge and experience on the part of the specialist assuming to cover it. To use some of the recent terminology in a metaphorical sense, the knowledge of this specialist must be "extensive," "intensive" and "focusing." It must extend over very nearly the whole range of the natural sciences—physics, chemistry, physiology, esthetics; it must deal with the particular applications of these in a thoroughly intensive manner, and it must always keep the vision focused upon common sense derived from actual experience.

The trouble with illuminating engineering at the present time is that many of those professing to be specialists or "illuminating engineers" are, as Bob Ingersoll once said of the new convert, "like bumble bees—biggest when they are first hatched." The knowledge and skill requisite to constitute an engineering profession is not something to be put on like a garment; it is something to be acquired by study and growth. There are undoubtedly a large number of specialists to-day who are entitled to take the professional degree of Illuminating Engineer, although in most instances they would probably be among the last to assume it. Unquestionably also, others will arise as time, study and experience will permit, and within a reasonable lapse of time we shall have a science and art of illumination which will justify its name, and specialists who dignify the profession. At the present it is well to remember that not all is gold that glitters, nor are all the glittering schemes of the self-styled illuminating engineer golden.

Installation of Service Meters at Rochester, N. Y.

In wiring buildings in the fire district of Rochester, N. Y., the underwriters will not permit anything but rigid or flexible conduit and armored cable. This, of course, results in rather expensive wiring installations, which, while they militate against rapid electrical progress in the heart of the city, nevertheless make excellent jobs both from the standpoint of the underwriters and also from the viewpoint of the wiring contractors. Taking advantage of this situation the Rochester Railway & Light Company has adopted a meter and service box which possesses numerous advantages, the chief of which is that it is impossible for a person so minded to tamper with the service outside of the meter and thus defraud the company.

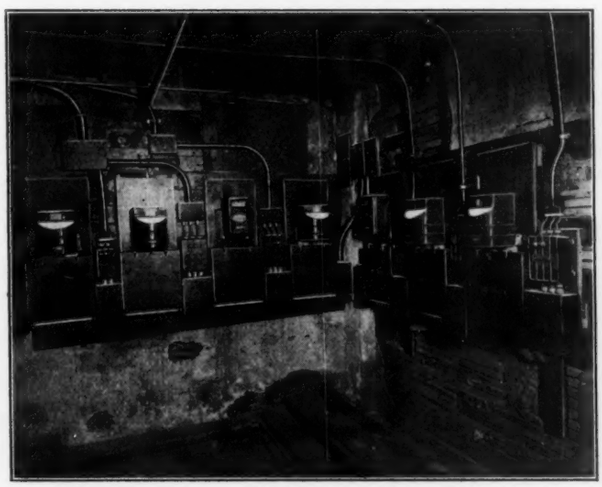


FIG. 1.—METERS IN THE CELLAR OF A ROCHESTER OFFICE BUILDING.

The service and meter box are usually placed in the cellar or basement where the company's mains are introduced. All connections between the service end and the meter board are run in iron conduit, and this also is true where the service is taken in overhead. The connections from the bracket to the cellar or basement are run in conduit down the outside of the building, and the service bracket is ordinarily secured to the wall of the building between the second and third floors or in the case of two-story buildings as close to the cornice as practicable. Typical meter installations are shown herewith. The service cut-out installed by the company is enclosed in an iron box and sealed. Such being the case, the underwriters allow the use therein of link fuses, which are cheaper than enclosed fuses, and since these are furnished and maintained by the company this feature alone means a considerable saving each year. Moreover, because the box is sealed, the underwriters require the customer to install a switch and cut-out on the house side of the meter and, by fusing the service box a little higher than the customer's main cut-out, the company experiences very little trouble with the link fuses in the service box blowing. On the other hand, if the customer places copper wire in his cut-out the house lines are still protected by the fuses in the company's service box, so that in this way overloaded circuits are eliminated, it being necessary in case the link fuses blow for the customer to notify the electric light company.

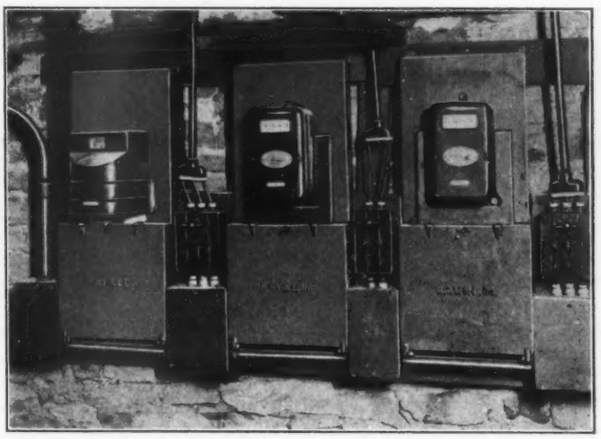


FIG. 2.—SERVICE BOXES FOR DIFFERENT STYLES OF METER.

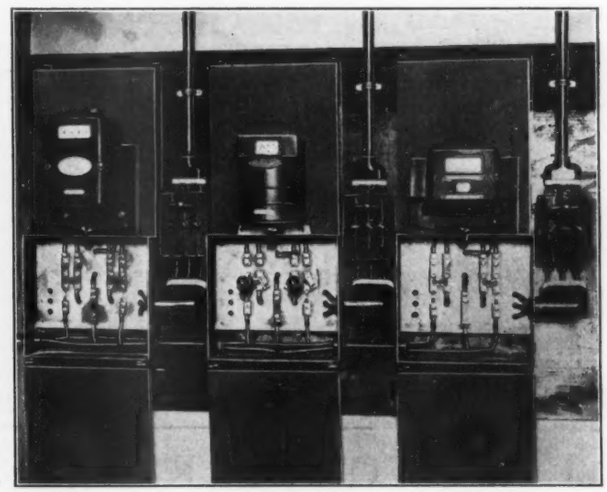


FIG. 3.—LATEST TYPE OF SERVICE BOX, SHOWING CONNECTIONS.

Another feature of the box is the ease with which tests can be made on the meter without depriving the consumer of electrical energy. The inspector who desires to inspect, test or change the meter, after breaking the seal on the service box inserts two common plugs in holes provided for the purpose,

as shown in Fig. 3, which represents the latest form of service box. When the plugs are inserted two copper links are disconnected, cutting out the meter without interrupting the service of the consumer. The plugs which are used to bridge or bypass the meter are provided with handles of such length that the door of the service box cannot be shut until the plugs are removed, thus making it impossible for the inspector to close or seal the box and leave the meter bridged.

The meter and service box is standard for all makes of meters and a special iron gutter is used for those makes of meter requiring connections at the side. In case a customer's service is discontinued, the meter may be removed and the service box sealed, thus leaving the service box and meter board ready for the installation of a new meter if at some later date the consumer calls for a reintroduction of service, at the same time preventing theft of electricity while the meter is out. The company has found that owing to the simple method of bridging the meter and connecting instruments and artificial load without interrupting the service, a tester can test about 25 per cent more meters per day than was possible when meters were installed in other ways. The company has over 2000 of these boxes in use at the present time. The excellence of the installations is well shown in the engravings. The older types are shown in Figs. 1 and 2, the latter also showing incidentally the variation in work done by different contractors. It would seem that it ought to be an easy matter to bring the condulet fitting and conduit directly over and close up against the customer's cut-out and thus cover up the short lengths of rubber-covered wire shown exposed. The lighting company is, of course, not interested except in a general way with that end of the work, as all energy passing through the wires thus exposed has already been measured by the meter. As shown in Fig. 3, the extra box has been eliminated for the service wires, the latter passing through the bottom of the box with the meter connections and the house circuit coming out through a short piece of conduit fitted with an approved outlet.

New Telephone Patents.

PRIVATE BRANCH CIRCUIT.

In the ordinary private-branch exchange it is necessary for two operators to take part in each call to one of the stations from an outside point. One of these is in the main exchange and the other at the private branch exchange. Each introduces cord pairs in the circuit, and upon completion of a conversation each receives one disconnect signal automatically and her own disconnection serves to send the second signal to the other operator. In order to provide the automatic display of the disconnect before the exchange operator through from the branch exchange extension, Mr. F. Arens, of Cincinnati, has invented a new system of circuits for private branch exchanges. The type of branch exchange is one in which for trunk connections the local cord pair is clear of the supply battery, all currents necessary for the connection being received from the main exchange cord pair over the trunk line. In order to control the signals properly with such a system, before the extension station has answered, it is customary to bridge the circuit with a retardation coil. Mr. Arens modifies this shunt circuit by carrying it through relay contacts which co-operate in such a manner that as soon as the called extension station answers, the shunt circuit is locked open until after the branch exchange cords have been cleared.

Letter to the Editors.

The United States Patent System.

To the Editors of Electrical World:

Sirs: In the report in your columns last week of the recent discussion of the U. S. Patent System at the Chemical Club, New York City, it is stated that none of the speakers had any fault to find with the present patent system. This unanimity of opinion is perhaps not surprising in view of the fact that of the speakers, three are patent lawyers, while the fourth is a professional inventor. It seems fair to assume that in any reorganization of our patent system in the interest of the deserving inventor, the patent attorney, being human, cannot be expected to lend active support if such reorganization should appear to affect his own interests; and as one of the abuses of the present patent system is the outrageous expense to the independent inventor in getting an application through the Patent Office in case it intereferes with "feeler" applications or conflicts with "protective" patents, as well as the subsequent legal expense in maintaining an invention in an art plastered with "protective" patents, it follows that any reorganization to correct this condition would presumably not redound to the profit of the legal profession. Moreover, the interests of the independent inventor are so opposed to those of the company inventor and to some classes of professional inventors, that little if any encouragement can be expected from these toward any movement in favor of the first-mentioned.

Perhaps 90 per cent of patents are issued to independent inventors, though their participation in the monetary benefit from the patent monopoly probably falls much below the cost to them of securing their patents. What the present situation therefore appears to call for is the organization of independent inventors in protection of their special interests, for they cannot look to the patent lawyer or the manufacturing company—the normal factors in the patent situation—to originate and carry out a movement in their favor. Through such organization concerted pressure could be brought to bear on congressmen, which should be extremely effective, since inventors who would be interested in the movement reside in practically every congressional district in the country.

After the above was written the newspapers have reported another patent scandal similar to that of the tungsten lamp case. Can it be successfully maintained that no fault exists in our present patent system when in both the Washington and Lockport cases the agency of disclosure of alleged gross patent abuse was the "secret service" activity of a manufacturing company affected by the alleged fraud? What are the chances of discovery and exposure of patent fraud against the average inventor without company or financial backing? In view of the Washington and Lockport cases, what assurance is there that scores or even hundreds of similar cases would not, by similar means, be uncovered? Lacking such assurance, is not a thorough overhauling of the present patent system demanded on this one count alone?

New York. James L. Terhune.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Dynamos, Motors and Transformers.

Loading of Active Materials of Transformers.—Hidetaro Ho.—An account of an investigation of the fundamental principles of the loading of the active materials (copper and iron) of alternating-current transformers and polyphase induction motors. For a given transformer, working with a given frequency, the net copper section of which remains constant, the output, the efficiency, the regulation, the power factor, etc., depend upon two things—the current density and the magnetic induction; or on the loading (Beanspruchung) of the active materials, copper and iron. The author discusses F. W. Carter's theorem on the best distribution of the losses between

the magnetic and the electric circuit of a transformer. The best distribution of the losses for any given output of a given transformer is such that the ohmic loss is equal to 0.8 $H + E$, where H is the hysteresis loss and E the eddy-current loss, or in other words, the copper and the iron must be loaded so as to satisfy this equation. Under these conditions the maximum efficiency is obtained for a given output. In order to increase in the most advantageous manner the output of a given transformer working in accordance with Carter's formula, it is necessary to increase the net cross-section of the copper as well as the total value of the magnetic induction. The author then gives the equations of the output and the efficiency. Having considered the efficiency and the division of the losses corresponding to a constant output he then modifies his equations, to make them applicable to the case of a variable load. Finally the polyphase induction motor is discussed in an analogous way. He finds that the knowledge of the principles of the loading of the active materials enables one to see at a glance on the test curves of an actual machine what to do in order to improve the working by the change of the number of turns of the primary winding.—*Jour. College of Engineering,* Tokyo Imperial University, Japan, Vol. IV, No. 4, August, 1908.

Wave Form and Transformers.—L. D. ROBINSON AND O. HOLZ.—The third article of their serial on the influence of wave form of e.m.f. on core loss and exciting current in transformers. The author gives the results of an actual test made with a 4-kw, 2080- to 150-volt transformer.—*Gen. Elec. Rev.,* January.

Weight and Cost of Generators.—A. G. ELLIS.—An article in which the author deals with the relative weights and costs of alternating-current and continuous-current generators, and particularly the influence of the rated speed and the rated output on these quantities. The curves given are based on designs for a large number of machines. The conclusions are that high speeds are distinctly more suitable for alternating-current generators than for direct-current generators, both as regards operation and manufacturing cost. In both cases there is, for each rated output, a certain speed at which the rate and cost reach minimum values.—Lond. *Elec. Eng'ing,* Dec. 31.

Alternating-Current Commutator Motor.—A note on a British patent (6960) of the British Thomson-Houston Company (General Electric Company of this country). Commutator motors, in which both inducing and exciting windings are arranged on the stator, may be started with the armature short-circuited, and, for high speeds, have a shunt voltage impressed on the armature to reduce the strength of the inducing field, which has an injurious effect on commutation at high speeds. It may happen that the armature ampere-turns exceed the inducing ampere-turns in the latter case, and the object of the present invention is to prevent this from having a bad effect on the commutation by arranging the inducing winding so that it is concentrated near the pole tips, where commutation occurs.—Lond. *Elec. Eng'ing,* Dec. 31.

Armature Reaction.—H. SCHOLL.—An illustrated article describing some experiments for demonstration purposes on the armature reaction of direct-current dynamos and motors. The author describes the method of making use of armature reaction for the excitation of direct-current generators and motors without any special exciting current.—*Phys. Zeit.,* Jan. 1.

Mercury Rectifier.—R. P. JACKSON.—An illustrated article describing the principles of construction and the applications of the mercury-vapor rectifier.—*Proc. Eng's. Soc. of Western Penn.,* December.

Lamps and Lighting.

Street Lighting.—N. R. BIRGE.—An illustrated article on modern methods of street lighting. The author first describes the luminous arc lamp and its operation from an alternating-current circuit by means of a mercury rectifier tube. He then considers the costs of operating a 100-lamp open-arc system and a 100-lamp series luminous-arc system with rectifier. In the following table the first column gives the figures for the open-arc and the second column for the luminous-arc rectifier:

Interest and depreciation	$72.00	$684.00
Maintenance	1,430.00	695.00
Energy	5,010.00	2,280.00
Total for 100-light system	$6,512.00	$3,659.00

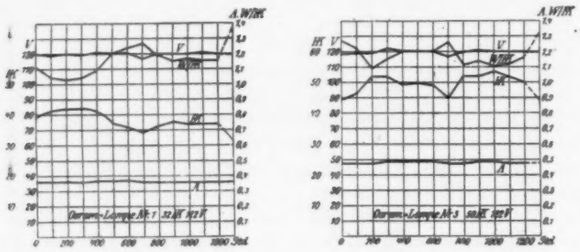
This shows an annual saving in favor of the luminous-arc rectifier system of $28.53 per lamp, or a total saving per year of $2,853. Therefore, the total net investment of $5,700 for the luminous-arc rectifier system will be paid for in about two years, after which the net annual saving will create a dividend of more than 50 per cent on the new investment. The author then deals with incandescent lamps and compares the cost of a carbon-lamp system with one of tungsten lamps, showing the great saving that can be obtained with the tungsten lamp. The station equipment for any series-incandescent system may be a part of the series-arc lighting outfit, with the lamps in series with the luminous-arc lamps; or it may be entirely separate. The former arrangement is generally the one employed in large towns and cities where both arcs and incandescents are used, and the latter in smaller places where only the incandescents are required. The author finally speaks of gas-incandescent lamps and emphasizes the wide variation of candle-power during the life of a Welsbach mantle. He finally compares lighting with 60-cp Welsbach mantles and 60-cp tungsten lamps. He finds the total cost per year (of 4000 hours) to be $8.15 for the tungsten lamp and $21.45 for the Welsbach mantle.—*Gen. Elec. Rev.,* January.

Street Lighting.—L. BLOCH.—A fully illustrated article on recent developments in the street lighting of Berlin. The author gives a detailed comparison of the various methods of street lighting now in use in Berlin. These methods include both high- and low-pressure gas lamps and flame and ordinary arc lamps. Measurements of illumination have in every case been made under actual working conditions, while in order to ensure a truer basis of comparison, in one or two instances the results thus obtained have been re-calculated for other heights of suspension. In conclusion, the author deals with the question of cost, but shows that from this point of view gas and electric lighting are not comparable, as so many opposing factors are present. With respect to illumination, his comparison of the two systems shows that the flame arc lamp is better than the inverted high-pressure gas lamp, as the continuous-current arc was better than the upturned high-pressure gas lamp. One or other of these may, however, be the cheaper, depending on the relative prices of gas and electricity.—Lond. *Electrician,* Jan. 1, 1909.

Flame Arc Lamps.—A note on a British patent (27,132) of the British Thomson-Houston Company (Allg. Elek. Ges. of Germany). In flame arc lamps with inclined carbons which contain mineral matter, the slag which is formed on the carbon tips frequently prevents the arc from striking when the circuit is closed. According to this invention, a metallic bridge with a knife edge is arranged at right angles to the plane of the carbons so that, when the lamp is switched on, the carbons strike this bridge. Any slag on the carbons is then removed, and the bridge forms a conducting path between the carbons so as to assist in striking the arc.—Lond. *Elec. Eng'ing,* Dec. 31.

Metallic-Filament Lamps.—O. BRANDT.—An illustrated account of tests of various metallic-filament lamps. Fig. 1 and Fig. 2 give the results of tests of osram lamps of 32 cp and 50 cp respectively. The curve A represents the amperes, B the volts, HK hefner candles and W/HK watts per hefner candle. The ordinates represent hours. The tests were made with alternating current from a municipal supply network. While the voltage was normally 120 volts, it increased in the evening to 128 or 130, and these variations of voltage did not seem to have any bad effect on the lamps. The author then gives results of tests of Just tungsten lamps, sirius colloid lamps, zirconium lamps, and other new lamps, all of which showed a comparatively short life, which may have been due to the considerable variation of voltage. The author finally compares

the cost of operation of a 32-cp carbon-filament lamp and of a similar osram lamp. With a price of energy of 13.75 cents per kw-hour he finds that the cost of operation of the carbon



FIGS. 1 AND 2.—TEST CURVES OF OSRAM LAMPS.

lamp is twice that of the osram lamp. For 50-cp lamps the ratio is even greater—namely, 2.5 to 1.—*Elek. Zeit.*, Dec. 31.

Zirconium Lamp.—A note on a British patent (5415) of the British Thomson-Houston Company (General Electric Company of this country) for producing filaments of pure zirconium or alloys of zirconium. A squirting solution of zirconium oxalate (which is itself gelatinous in nature) is prepared by precipitation of hot zirconium nitrate solution with ammonium oxalate. Sufficient powdered carbon is then mixed with this to combine with the whole of the residual oxygen of the oxalate during the heat treatment. The absence of pitch or other carbonaceous binder ensures freedom from volatile hydrocarbons in the furnace, and consequently a filament entirely free from carbon is produced. In the case of filaments of an alloy of zirconium, the gelatinous zirconium ozalate forms the only binding agent for the mixture.—Lond. *Elec. Eng'ing*, Dec. 31.

Power.

Consumption of Fuel in Power Stations.—F. H. Corson.—An abstract of a paper read before the (British) Institution of Civil Engineers. In 1903 the average coal consumption of 34 principal generating stations of the United Kingdom was about 7.7 lb. per kw-hour generated. The figures ranged from 3.6 lb. to 15 lb. In this list the central station of Blackburn stood at 10 lb. per kw-hour. In order to improve the condition, the steam-pipe system was overhauled and more effectively drained, and steam separators and driers were in consequence dispensed with. Engine stop valves were, where possible, attached directly to the main steam pipes. The steam ring was discarded, and generally the effective heat-radiating surface was greatly diminished. Better fitting boiler dampers were provided, the condition of the brickwork was improved, and the whole process of combustion was more thoroughly controlled by the institution of flue-gas analysis. These and similar alterations occupied about three years, and the fuel consumption fell during that time to about 6 lb. of the same coal per average kw-hour generated, a reduction of 40 per cent. Further detailed investigations of the various losses and improvements were then made. An extended test of the whole plant under ordinary working conditions was then arranged. The station comprises two adjoining stations of 2300-kw capacity each, containing 12 mechanically-fired Lancashire boilers, six fitted with superheaters; 15 high-speed engines driving generators from 60 kw to 775 kw in size, controlled from three switchboards; steam piping 3 in. to 14 in. in diameter; ejector and jet condensers fed from an overhead water-tank above the boiler house; low-speed, steam-driven feed pumps; four batteries of economizers totaling 1504 tubes; two chimneys, 150 ft. and 250 ft. high respectively. The test covered during 168 consecutive hours the combustion of about 230 tons of coal, the evaporation of 3.376 million pounds of water, and the generation of 99,295 electrical kw-hours. The net results show a consumption of 5.15 lb. of coal, and a total evaporation of 33.9 lb. of water per average kw-hour.—Lond. *Elec. Eng'ing*, Dec. 31.

Water-Power Stations.—H. von Schon.—A paper recommending the procedure in analyzing a hydro-electric project. The investigation should consist of three distinct functions, which should be treated as separate operations and topics—namely, the market, the approximation of output and cost, and the precise estimate of these; when thus approached there need be no costly disappointments. The initial treatment of the market and approximate output and cost topics need not be costly, nor do they require much time, while the expense of the precise determination of the two latter may reach 2½ per cent of the cost of small undertakings of this character and somewhat less for larger ones, and will require sufficient time to make the detail surveys and prepare the plans and specification. An account of the long discussion which followed the paper is also given.—*Jour. Western Soc'y of Eng.*, December.

British Power Companies.—Statistical tables giving information concerning various British power companies supplying power in bulk.—Supplement Lond. *Electrician*, Jan. 1.

Traction.

Tramways in Germany.—A statistical note stating that the total length of tramways in Germany on March 31, 1907, was 2153 miles; the number of two-axle motor-cars was 8378, of four-axle motor-cars 1164, and of electric locomotives 63. The number of fatal accidents was 170 and the number of injured 743, as against 146 and 669 in the preceding year. Some interesting information regarding the tramway undertakings in the principal German towns is given in the accompanying table.

Towns.	No. of inhabitants.	No. of persons carried. Millions.	Length of track. Miles.	Receipts per passenger. Cents.
Berlin	3,013,000	481.1	231	2.45
Hamburg-Altona	971,000	157.2	107	2.60
Munich	539,000	64.3	40	2.50
Dresden	517,000	87.5	57	2.63
Leipzig	503,000	86.4	56	2.30
Breslau	471,000	55.3	34	2.00
Cologne	429,000	76.7	45	2.18
Frankfort	395,000	68.6	43	2.38
Nuremberg-Furth	355,000	29.6	18	2.30
Elberfeld-Barmen	319,000	27.4	17	2.42
Hanover-Linden	308,000	39.5	24	2.60
Düsseldorf	253,000	34.6	21	2.28

—*Zeit. f. Kleinbahnen*, abstracted in Lond. *Electrician*, Jan. 1.

Electric Railway Statistics.—Statistical articles and tables on electric railways in the United States in 1908, giving information on new interurban railways in the Central States with map; on electric railway receiverships; on electric railway track construction; on electric railway rolling stock ordered, and on signals installed on electric railways. The total new mileage represented in the tables is 1259.—*Elec. Railway Jour.*, Jan. 2.

High-Tension Current Collectors.—O. A. Kenyon.—An illustrated article summing up the results of the Swedish electric railway tests with respect to the collecting of high-tension current from an overhead wire at high speeds. The conclusion reached by the author is as follows: The results of experiments made thus far seem to point to a type of collector which should consist of two parts—namely, a main part to take up the large variations in the height of the wire and an auxiliary part to take up the vibrations. The main part may be comparatively large and heavy and should be balanced for wind pressure and provided with springs arranged to exert a constant pressure irrespective of the position of the shoe. The auxiliary part, which should trail, must be light and designed to have a high natural period of vibration which will enable it to follow the most rapid vibrations of the car to which it will be subjected. The same issue contains two letters by T. Varney and W. S. Murray on comparative tests made with bow collectors and pantographs on the New Haven Road.—*Elec. Railway Jour.*, Jan. 9.

Electric Automobiles.—E. Sieg.—The conclusion of his illustrated paper. The author discusses the advantages of the electric automobile for street and suburban service (not for touring cars) and especially for fire-engine service. He also discusses the methods of suspension of the motors, the tire question, etc., and gives data on cost of operation and maintenance. A maintenance cost of the battery of 1.25 to 2 cents per kilometer is considered as normal.—*Elek. Zeit.*, Dec. 31.

Wires, Wiring and Conduits.

Distributing System.—H. B. Gear.—A paper on the development of an alternating-current distributing system, discussing

the secondary distribution system, the network, transformers, primary mains, feeders, two-phase and three-phase systems, and construction methods, especially as to overhead work and underground lines.—*Jour. Western Soc'y of Eng.*, December.

Electrophysics and Magnetism.

Oscillations.—E. JACOB.—An account of an experimental investigation of the spark discharge in oscillation circuits. The investigation was made with the aid of an oscillograph and the logarithmic decrement of damping was determined as function of the spark length, current, electrode material, nature of gas, and subdivision of the spark gap. With constant current the damping increases with increasing spark length, while with constant spark length it increases with decreasing current. That electrode material which has the greater heat conductivity also shows a greater damping. The action of the surrounding gas is of the same nature. The damping increases with subdivision of the spark length. The phenomena are explained by the properties of the spark-gap as a high-frequency alternating-current arc.—*Phys. Zeit.*, Jan. 1.

Cooling Curves.—G. K. BURGESS.—A critical discussion of the different methods of obtaining cooling curves (temperature-time curves, differential curves, direct and inverse rate curves). The one from which the most comprehensive view of a transformation can be obtained is the simple temperature-time curve, when this method is made sufficiently sensitive. The curve that can be made the most sensitive and certain is the differential curve. For great range, combined with greatest sensitiveness, the most certain and complete data may be obtained by combining the temperature-time observations with those obtained by the differential method.—*Bull. Bureau of Standards*, Vol. V, No. 2 (November).

Thermodynamics.—C. P. STEINMETZ.—The first part of a serial on the principles of thermodynamics. The author explains why the conception of heat energy as the energy of irregular molecular motion is founded on a very reasonable basis. Molecular motion can be either progressive or rotary motion. According to the value of the molecular velocity, the material is in the solid or liquid or gaseous state. The author then shows how by very simple consideration it is possible to derive the fundamental gas laws.—*Gen. Elec. Rev.*, January.

Electrochemistry and Batteries.

Capacity of Lead Accumulators.—Y. FURUYA.—The author first sums up former researches on the influence of discharge rate and acid density on the capacity of lead accumulators, and then describes experiments of his own. His tests show that the time rate of the drop of voltage at the terminals of the cell near the end of the discharge is independent of the discharge rate (the discharge current). This means that when the voltage at the terminals of the cell has reached a certain value near the end of the discharge the further discharge curve is exactly the same whatever the rate of discharge. It is wrong to define the capacity by stopping at that point when the voltage at the terminals has become 10 per cent less than the initial voltage. The author recommends to define the capacity as that quantity of electricity which a fully charged battery gives out until the time rate of the drop of voltage has assumed a certain value. If discharge curves are taken with the given storage battery, but at different discharge rates and with different acid densities, the curves agree together in their later parts. The difference between a discharge curve at a low rate and a discharge curve at a high rate is only in the beginning part of the low-rate curve. This part does not exist in the high-rate curve, but is a direct prolongation of the latter beyond its initial point to the left. In this way it is possible to devise a graphical method of determining the time of discharge for different acid densities and for different discharge currents from one fundamental discharge curve (referring to a low-discharge rate and a high-acid density).—*Jour. College of Engineering*, Tokyo Imperial University, Japan, Vol. IV, No. 4, August, 1908.

Calculation of Battery Capacity for a Given Load.—W. LULOFS.—W. Peukert has published the following formula, which expresses the capacity of a cell as function of the length of discharge, provided the cell is fully charged and not discharged below 1.8 volts. The formula is $C^n t = a$. Where C is the discharge current and t the length of time the cell is discharged at a current of C amperes; n and a are constants, the former depending on the construction of the plate—namely, on the alteration in the composition of the active material and electrolyte surrounding the active material—and on the alteration in resistance of the electrolyte and active material as the discharge proceeds; whereas a is simply dependent on the current density—i. e., on the number of plates each cell contains. For this reason the two constants may have different values for different makes of cell. The above formula can be used to calculate theoretically the right size of cell—i. e., the required number of plates per cell for a given amp-hour demand should n and a be known. The shape of the load curve gives the required current at each moment, and these currents, when raised to the nth power, permit a new curve to be constructed whose area is $C^n t$, and whose value can be obtained with a planimeter. The cell whose constant a is equal to or near this value is the type required. In the present paper the author shows that Peukert's formula also holds good for storage batteries of English make. The constants for the same are given.—Lond. *Electrician*, Jan. 1.

Electric Heat.—An anonymous note in which the writer investigates the cost of heating by electrical means for such metallurgical processes as the electric furnace is suitable, and points out that owing to the much more efficient way the heat is applied, the actual costs of direct heating by fuel and electrical heating are not so different as might be imagined.—Lond. *Elec. Eng'ing*, Dec. 31.

Units, Measurements and Instruments.

Interrupter.—An illustrated note on a new interrupter for induction coils which is said to give strong effects without wear and tear of the contacts. The arrangement is shown in Fig. 3.

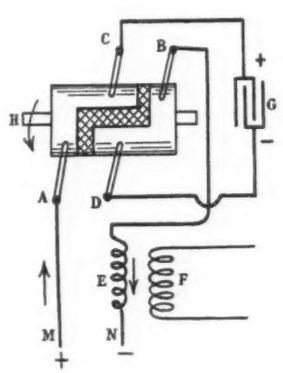


FIG. 3.—DIAGRAM OF NEW INTERRUPTER.

A commutator is fixed on an axle H driven by a motor and two brushes A and B are connected to poles M and N of a source of direct current. The other pair of brushes C and D are connected with the plates of an electrolytic condenser consisting of two aluminum plates in a solution of bicarbonate of soda. E is the primary of the induction coil, F the secondary. When the commutator revolves the condenser G is alternately charged and discharged. The fluctuation of the current in E produces an induced current in F. The electrolytic condenser consists of a cell of 25 cm x 25 cm x 30 cm containing aluminium plates as electrodes. Its capacity is 500 microfarads.—*L'Industrie Elec.*, Dec. 25.

Tuned Wireless Telegraphy.—At the recent exhibition of the Physical Society in London, the Marconi Wireless Telegraph Company showed a multiple tuner for tuning a wireless telegraph receiver so as to render it immune to interference from other stations. It can also be used for measuring the lengths of the transmitted and received waves and for estimating the distance of a known station. The instrument has been designed so as to stand severe climates and comparatively rough

usage, and is suitable for all wave lengths from 300 ft. to 8000 ft. Its general principle is shown in Fig. 4, where A represents the aerial, E the earth, R the receiver or detector. There are three separate circuits, termed the aerial circuit, the intermediate circuit, and the detector circuit. The aerial circuit passes from the aerial A, through the aerial tuning inductance I, aerial tuning condenser C_1 and aerial inducing inductance P_1 to the earth at E. The intermediate circuit consists of two equal inductances S_1 and S_2 connected in parallel to the intermediate tuning condenser C_2. The detector circuit consists of an inductance P_2 in series with the detector tuning

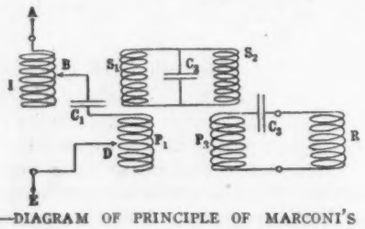


FIG. 4.—DIAGRAM OF PRINCIPLE OF MARCONI'S TUNER.

condenser C_3 and detector R. The inductances I and P are adjustable at B and D respectively, and the condensers C_1, C_2 and C_3 are all adjustable, so that the three circuits can be tuned to the received wave length. The oscillations in the aerial circuit then induce (by means of P_1 and S_1) oscillations in the intermediate circuit, which in turn induce (by means of S_2 and P_2) oscillations in the detector circuit. In addition to the above adjustments, the two coils S_1 and S_2 may be rotated relatively to the coils P_1 and P_2 so that the couplings between the three circuits may be varied. The condensers C_1, C_2 and C_3 are continuously variable from zero to a maximum of 10 jars (a jar being 1000 cm), but the range of the instrument is increased by other condensers placed in parallel or series by means of the tuning switch. In addition to the parts shown in Fig. 4, the instrument is fitted with a micrometer spark-gap and shunt inductance (of the order of 80,000 microhenries) connected between the aerial and earth terminals to prevent the accumulation of an electrostatic charge in the aerial, with a change switch by means of which the whole of the tuned circuits may be cut out, and with a tuning switch by means of which the capacity in the intermediate and detector circuits may be increased to a maximum of 30 jars. When signals from the station to which it is required to communicate are received the aerial tuning inductance and the aerial tuning condenser should be adjusted till the strongest signals are obtained. The intensifier handle is set to 90 deg., and the tuning switch to the wave length roughly indicated by the amount of the aerial tuning inductance and condenser. Then the change-over switch is thrown over to position "tune," and the intermediate and detector condensers varied together till the best signals are obtained. After again adjusting the aerial tuning condenser to give the strongest signals, and if interference is found, the intensifier handle is adjusted to a small valve and the condensers are again adjusted. It will be found that the further the intensifier handle is turned from 90 deg. the sharper will the adjustments of the condensers become, and the greater will be the freedom from interference.—Lond. *Electrician*, Jan. 1.

Wireless Telegraphy.—H. Poincaré.—The conclusion of his serial of lectures on the theory of wireless telegraphy. The author discusses the transmission of electromagnetic waves in a certain direction.—*La Lumière Elec.*, Dec. 26.

Miscellaneous.

Porcelain.—H. T. Harworth.—A paper on the electric qualities of porcelain, with special reference to dielectric losses. The author gives curves of the charge of a porcelain condenser as function of the time of charge; of the dielectric constant of porcelain as function of the temperature; of the apparent conductivity of porcelain (ratio of current to potential) as function of the potential; of the time of electrification, and of temperature. The influence of temperature on apparent conductivity of porcelain is shown in Fig. 5. It will be seen that the increase of conductivity with temperature is very great. The following is the equation for the porcelain used in these tests: The specific conductivity of porcelain, calculated at 20 deg. C., is 0.2624×10^{-13} mhos. per cm. cube. There is a loss of energy in putting a porcelain condenser through a cycle of electrification. Dielectric loss per cubic centimeter in the time t seconds is $1.83 \times 10^{-12} V^{1.14} (f + 14.4) t$ joules where V is the root-mean-square potential gradient per centimeter and f is the number of cycles per second. The constant 14.4 is probably due to the porcelain not being a perfect insulator.—Lond. *Electrician*, Jan. 1.

Porcelain for Electrical Purposes.—A. Zoellner.—A discussion of the properties of porcelain as an insulating material from a physico-chemical standpoint. The different steps in the manufacture of porcelain insulators are described and it is emphasized that the most important chemical changes within the mass take place near the highest temperature used (about 1400 deg. C. to 1450 deg. C.). During the last 100 deg. C. of the heating process the final decomposition of the raw materials and the intimate interconnection of the crystals take place, providing the perfect density which protects against absorption of water. The treatment during this very last step increases greatly the resistivity of porcelain against variations of temperature and also its electric perforation strength. High-tension insulators intended for 40,000 volts have shown differences up to 10,000 volts in perforation strength according to comparatively small differences in the temperature used during manufacture. The silent discharge observed with high-tension insulators is intimately connected with air bubbles within the porcelain. These air bubbles slowly increase in size and finally a disruption discharge takes place. From an electrical stand-

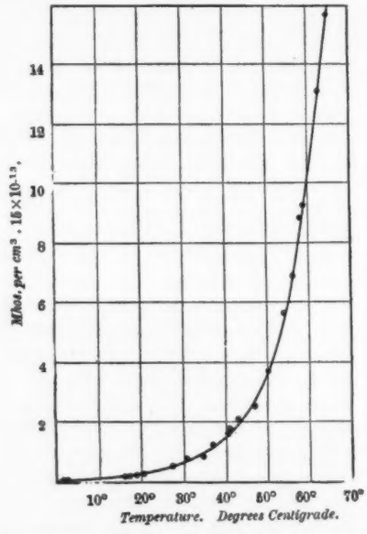


FIG. 5.—APPARENT CONDUCTIVITY OF PORCELAIN AS A FUNCTION OF TEMPERATURE.

point air bubbles in porcelain are, therefore, of greatest importance, even if the mass of the porcelain itself is faultless. The composition of the standard mass has been given by A. S. Watt as $0.25\ K_2O\ 1Al_2O_3\ 4SiO_2$ and this agrees almost exactly with the analysis of the author of the material used by a German insulator factory.—*Elek. Zeit.*, Dec. 31.

Multi-Tone Vibrating Transmitter.—An illustrated description of the Raymond-Barker multi-tone vibrating transmitter. This instrument is a development of the Cardew vibrating transmitter, and enables the principle to be utilized for codes made up of two notes, three notes, or any number of notes. The only receiver required for these multi-tone acoustic signals is a single telephone, although several telephones may be joined up if so desired. For reception of visual or recorded signals, respectively, a mirror galvanometer or a Kelvin syphon recorder may be used, the received signals emanating, in this last-mentioned case, from a two-toned transmitter sending positive and negative undulatory signals to the line.—Lond. *Elec.*, Dec. 18.

NEW APPARATUS AND APPLIANCES

New Magneto Telephone Set.

The Western Electric magneto telephone set shown here marks a departure in several respects in the design of this class of apparatus. The changes introduced have been with a view to making the set as a whole more efficient, the different parts more accessible for inspection and maintenance, and the outward appearance of the set more attractive.

One of the most noticeable of these changes to the average telephone user is the absence of the line binding post from the top of the set. As it has been the practice of the Western Electric Company for some years past to place the telephone protectors at the point where the line wires enter the building, and since all the inside wiring and the building itself are thus protected, no provision is made for the protector on the set, which are seldom, if ever, installed at the point where the line wires enter the building. Moreover, a protector of the usual design when placed on the set introduces danger of personal injury and of fire on account of its proximity to the user and to inflammable material, such as curtains; it is also liable to be tampered with and dust is apt to settle on it and ground the line. This practice dispenses with exposed binding posts on the telephone. The leading-in wires enter the set from the rear and this not only improves its outward appearance, but prevents accidentally short-circuiting its main binding posts. The top of a wall telephone set is a convenient spot on which to place articles, and many a telephone set with exposed binding posts at the top has been temporarily put out of service by some metallic object being unknowingly placed between them. Obviously, this would be impossible in the set illustrated herewith.

Accessibility to the working parts has been made a special feature in the design of the cabinet, in the mounting of the apparatus and in the left-hand swing of the door. Opening the door toward the left facilitates inspection of the generator while turning its crank—an important feature in time of need. The five-bar hand generator included in the set is stated to

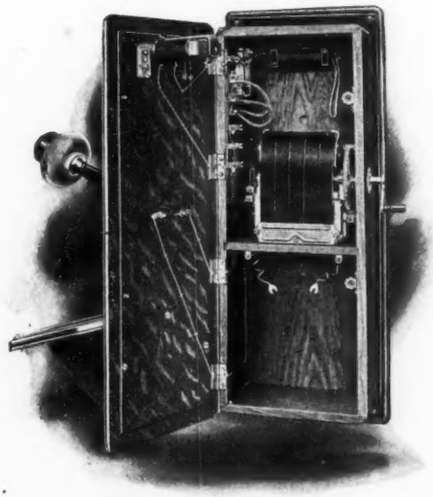


FIG. 1.—MAGNETO TELEPHONE SET OPEN.

show from comparative tests an efficiency of from 13 per cent to 70 per cent greater under practical working conditions than other hand generators on the market, and is guaranteed to ring the equivalent of forty 2500-ohm bells on a 30-mile full metallic line of No. 12 B. W. G. iron wire. The transmitter and receiver are stated to have the same high talking qualities for both local and long-distance transmission as the transmitters and receivers supplied by the Western Electric Company to all telephone users. The ringer is easy of adjustment and gives a loud, clear signal. The switchhook is compact and self-contained.

Telephone sets of the description here noted are manufactured by the Western Electric Company for moderate and heavy-load bridging service where code ringing is employed,

FIG. 2.—MAGNETO TELEPHONE SET.

either with or without a condenser in the receiver circuit. The condenser insures the ringing of the bells even if a receiver is left off the hook. Each set, as shown, is complete and ready for use with the exception of the dry cells.

Bevel Gear Cutters.

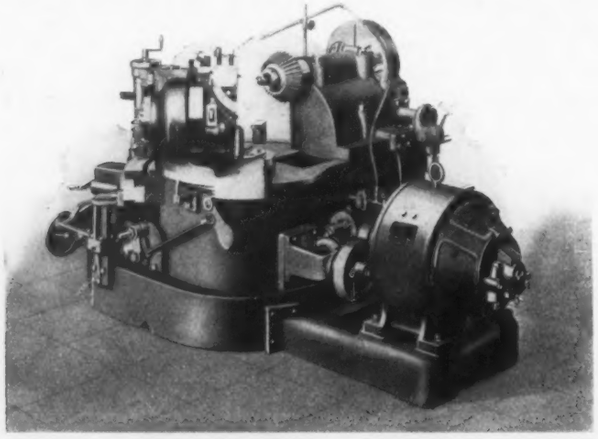
The use of cut instead of cast gears has grown enormously within the last few years, because of the demand for high-power gearings which shall run with a minimum of wear and noise. Correspondingly the machines which cut the gears have been developed greatly in this time to supply the heavy demand. The illustration shows a very compact and efficient machine provided with an individual electric motor, for planing bevel gears of any angle, eight or more to one, and any size up to 24-in. pitch diameter. This is known as the 24-in. automatic bevel gear planer, and is manufactured by the Gleason Works, of Rochester, N. Y.

This machine will plane bevel gear teeth to cone lines. The curve tooth of formers is produced by a machine which generates the curve. The resulting formers are absolutely correct, as the machines have been designed and built exactly for this work. The three formers necessary for cutting a gear, one for roughing, a second for the upper side of the teeth and a third for the under side of the teeth, are in a revolving holder, so that they are brought into position successively without removal of one to give place to the next.

The gear planer is driven by a standard, constant-speed, shunt-wound, Westinghouse, 5½-hp, 1135 r.p.m. motor fully enclosed. This size of motor provides ample power to cut the largest size of gears for which the machine is designed. The motor is connected through a system of gearing to the planer,

and, as shown in the illustration, is mounted on a base bolted to the standard base of the gear cutter. This provides a compact unit which is independent of all belts and shafts, so that it may be located at any point in the shop which convenience dictates.

These gear planers cannot be continuously working from morning to night, for in common with machine tools in general, the work is of a more or less intermittent character with



MOTOR-DRIVEN AUTOMATIC BEVEL-GEAR PLANER.

periods where the driving motor either runs light or may be shut down entirely. Motor drive effects a material saving in power because the machine takes power in proportion to the work it turns out, and thereby reduces the cost of planing the gears to a minimum. The individual motor tool also results in better headroom and freer access for crane service.

The Gleason Company also manufactures other sizes of gear planers and cutters, ranging from a capacity of 15 in. up to 180 in. as a maximum. On the smaller sizes a constant-speed motor is used, but for the four larger sizes an adjustable speed motor with a speed range of 2-to-1 is recommended.

Lamp and Scale for Galvanometers.

A lamp and scale, having several new features, has been recently placed on the market by the Leeds & Northrup Company, of Philadelphia, Pa. On account of the construction, it

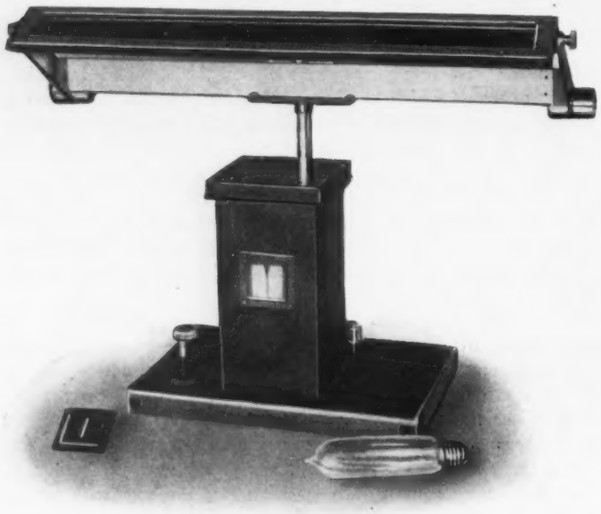


FIG. 1.—LAMP AND SCALE FOR GALVANOMETERS.

may be used in a well-lighted room, or in one with no light but that contained in the instrument itself. This feature makes it applicable for use in wire factories and laboratories with natural illumination. When used in daylight, a straight-filament lamp and narrow-slot projector are used, resulting in throwing a brilliant white line on the scale. If used in a place too dark to read the scale without artificial illumination, a window of ground glass is introduced into the hood, in place of the slot, in conjunction with a special lamp to concentrate the light. This window has on it a black arrow and line which is projected on the scale. As shown in Fig. 1, the scale is

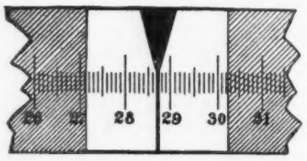
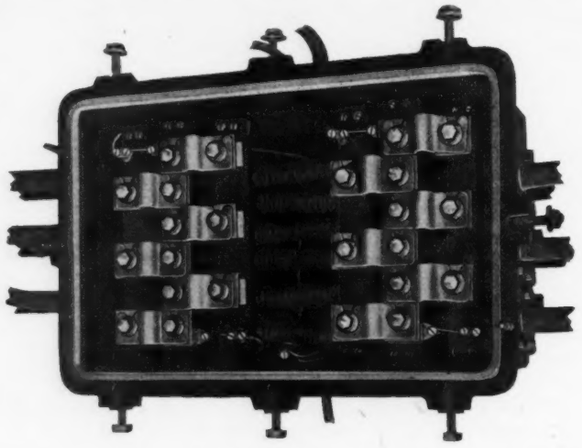


FIG. 2.—SECTION OF SCALE.

thus brilliantly illuminated on both sides of the arrow, and the figures may be easily read, although the room is otherwise in perfect darkness. Every instrument is equipped with both outfits, which are easily interchangeable. Another feature of the instrument is the construction of the reading device. In place of the ground-glass scale usually employed, one of fine white cardboard on a mahogany back is substituted. The light, falling on this, makes a sharply defined image which the observer, standing behind the instrument, reads by means of a long, adjustable mirror. With this scale, the observer may stand to one side of the instrument and still be able to read as easily as if he were in front.

Cable Junction Box.

The accompanying illustration shows a cable junction box brought out by the Ricker Manufacturing Company, of Rochester, N. Y. This box is used to protect the mains and feeders of a two- or three-wire, 250-volt system at junction points; each cable being protected with a fuse and the box making a very convenient place to test for trouble. The box is especially adapted for a three-wire system with grounded neutral; the neutral being grounded to the box. A socket is provided in the side of the box where a lamp can be used for illuminating the manhole when work is being done in it or about the junction box. The cable terminals are designed to take mains up to 500,000 circ. mil and feeders up to 1,000,000 circ. mil. The box is watertight and being very compact does not require very much room in the manhole. Plenty of space is left for insulation and the fuses used are of standard make with large terminals, thus eliminating heat and the possibility of the fuse melting because of too small a contact. The flanges are made of



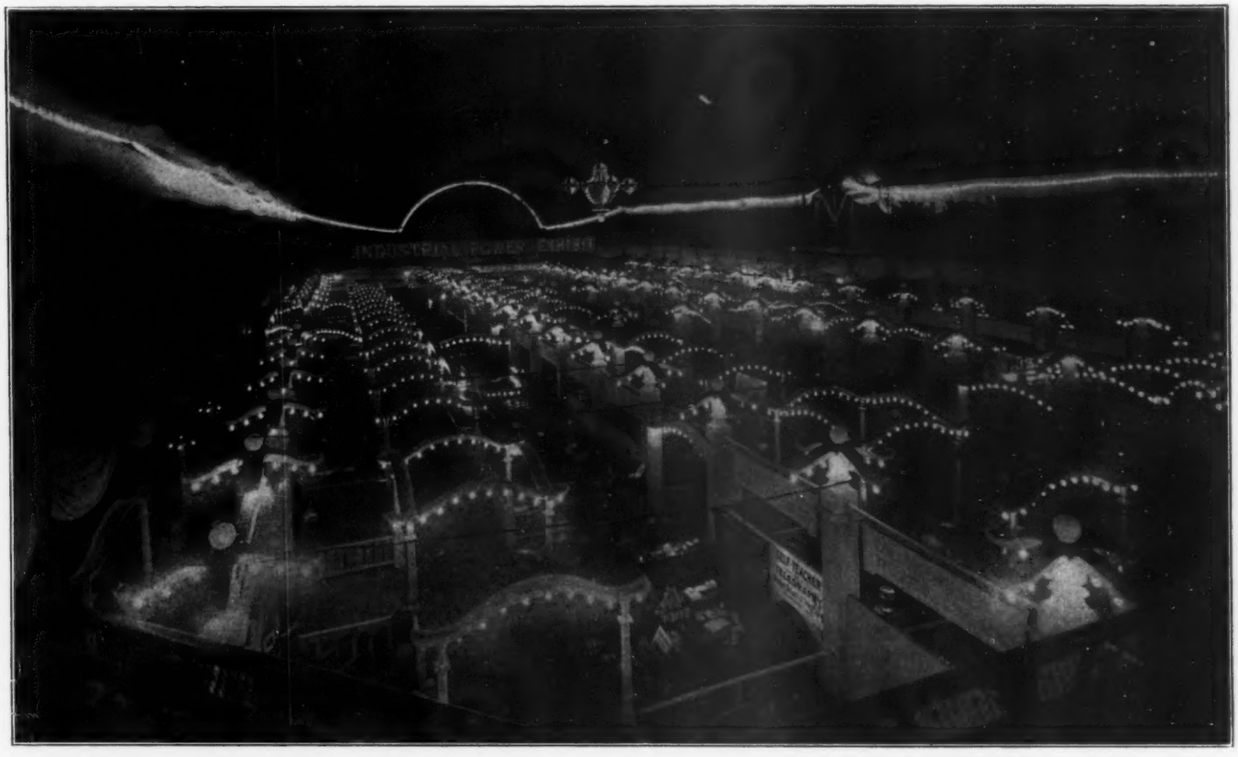
CABLE JUNCTION BOX.

brass and are countersunk, so as to allow a close wipe to the armor of the cable, shortening the distance lengthwise, and leaving additional space in the manhole for other uses.

Fourth Annual Chicago Electrical Show

THE fourth annual electrical show, which has been successfully put through at Chicago, was opened in a very businesslike manner the afternoon of Saturday, Jan. 16. Previous shows, notably the first, were more spectacular in their openings, which were in the evening and accompanied with packed aisles. This year's opening on an afternoon, at which admission was only by invitation of exhibitors or management, was more satisfactory to those who prefer real business and opportunity to look at exhibits to the pushing and crowding that seem to be inseparable from an evening opening with both a large invited list and paid admissions.

The annual electrical show has come to be one of the most popular of the numerous annual shows in Chicago. It attracts every evening as many people as the Coliseum, where it is held, can comfortably accommodate. One evidence of its general popularity is the fact that nearly all the cartoons in the Chicago morning papers the day of the opening had some reference to the show.



GENERAL VIEW OF CHICAGO ELECTRICAL SHOW, WITH STARLIGHT EFFECT.

It was a matter of considerable speculation what the Electrical Trades Exposition Company management could devise to improve on last year's decorative scheme of lighting with its festoons and spheres of light and its generally brilliant effect. The answer was a starlit sky. The booths and aisles were even more lavishly lighted than usual with tungsten instead of carbon-filament lamps. But up high overhead, instead of the former array of bright lights, was what appeared to be a dark sky studded with twinkling stars. On a dark background a lot of small incandescent lamps had been placed in flashing sockets. The effect was a pleasing variation from the former methods.

As to the exhibits themselves, the two most striking things indicating the development of the last year in the field of popular appliances are the use of tungsten lamps throughout and the increasing number of vacuum cleaning appliances now offered. In both there have been notable improvements in the past year.

The central-station exhibit of the Commonwealth Edison Company this year is devoted to industrial power applications. Several small factories are in operation in the large space occupied by this company, among which may be enumerated a printing office, a bakery, a furniture factory, metal specialties factory, a knitting factory and numerous other miscellaneous applications.

The United States navy exhibit, which occupies the annex of the Coliseum, is very instructive to the public as to the lighter guns of the navy and their equipment.

AERO AUTOMATIC FIRE ALARM COMPANY, Milwaukee, Wis., is exhibiting an electro-pneumatic fire alarm which has been recently approved by the National Board of Fire Underwriters, and has many novel features. This device is operated by expansion of air in a small copper tube which operates a silver bellows. The bellows works in conjunction with an adjustable orifice which allows for the escape of air during gradual heating, but not sufficient to prevent the bellows from operating and closing the electric contacts in case of sudden rises in temperature. Each copper tube is run in a loop from the switchboard through the room or area to be protected and back to the switchboard, where a small test box is located. By this test box the pressure in the tube may be raised at any time, so that the working condition of the system may be readily ascertained. The company is represented by Malcolm H. Baird.

ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has one of the attractive booths to be seen at the show this year. The space occupied by the company is very tastefully decorated with palms, ferns and cut flowers and the floor is covered with Oriental rugs. A large reception room has been provided in which are a number of chairs and settees where the friends of the company are invited to spend their spare time. The exhibit

was planned to represent the fact that the company is prepared to build complete power and electrical machinery for every class of service, including gas engines, Corliss engines and hydraulic turbines. At one side of the booth the company has an induction motor-generator set of 50-kw capacity. Other apparatus shown is a set of standard induction motors for alternating current and the company's new type-K motors for direct current; various sizes of power and lighting transformers, motor-driven centrifugal pumps and the blading and other parts which are used in the construction of steam turbines and generators. The exhibit is in charge of C. A. Tupper, the advertising manager of the company. The other representatives in attendance are: Mr. W. H. Whiteside, W. S. Heger, M. C. Miller, L. F. Bower, Henry Woodland, J. R. Jeffrey, E. T. Adams, W. J. Sando, L. E. Strothman, Geo. C. Forgeot, Max Rotter, W. W. Powell, James W. Gardner, L. M. Harvey, E. M. Gerry, C. A. Bickel, A. N. Brown, W. C. Robinson, R. Dill, W. S. Bishop, Russell Bower, J. R. Ferguson, W. H. Yates, J. M. Kingsbury, G. S. Burdick, W. G. Hammond, R. F. Smith, A. H. Wyman, J. S. Jackson, F. L. Neely, Wm. R. Crawford, I. L. Dimm, E. A. Wright, M. L. Embrey, R. T. Herdegen, C. D. Lutton, S. R. Kerr, C. S. Buell, Ervin Dryer, J. M. Denniston, D. K. Chadbourne, H. I. Keen, A. W. Catlin, Chas. M. Howe, R. H. Gaither, C. M. McDonald, C. M. Nicholson, L. St. J. Smith, H. A. Balding, W. J. Bishop, C. E. Searle, D. P. Davies, R. D. Tomlinson, L. C. Marburg, Willis Collins, C. A. Shearer, P. A. Himes, Alfred Ernst, E. W. Tucker, R. B. Williamson, L. E. Boyen, B. Frankenfield, C. B. Flory, W. F. Uhl, Charles C. Tappan.

American Telegraph & Telephone Company, Boston, Mass., has a booth in connection with the exhibit of the Chicago Telephone Company in which are located long-distance telephone booths. The company has a large map located at the front of its booth on which is shown the lines operated by the Bell Telephone Company throughout the United States and Canada.

American Automatic Advertising Company, Chicago, Ill., is exhibiting several of its automatic moving-picture advertising machines. Each one of these machines holds 24 different views which change automatically. These machines are designed to be used in display windows. They are operated by electricity, connection being made through the standard socket used for electric lights.

American Electric Fuse Company, Muskegon, Mich., is exhibiting and calling special attention to its American igniter, which has been designed especially for gasoline engine ignition purposes. It is in brief a self-contained timer coil and distributor and is so constructed that it can be mounted directly on the camshaft of a gasoline engine. It is especially recommended by the company for service on automobile, marine and stationary engines. The igniter is shown connected to a revolving spindle which is driven by an electric motor. The company also is showing at its booth a full line of lightning arresters of both aerial and switchboard types, including the well-known self-cleaning arrester, No. 600; also a full line of distributing frames for small telephone exchanges; a sample line of telephone protective apparatus as well as the American black insulated wire, wire splices and Allen-Bradley motor starters and controllers. The company is represented at the show by Frank G. Jones, G. W. Rodormer, R. C. Da Costa and George Padley.

American Steel & Wire Company is showing all of the electrical products manufactured by this company, including electric wires and cables, as well as trolley wire and a very complete line of rail bonds and rail-bonding tools; sample boards also showing a large variety of wire products both round and flat, including springs, wire rope, wire nails, etc. B. H. Rizer, representing the Chicago sales department, and C. R. Sturdevant, of the engineering department, are in attendance.

A. & J. M. Anderson, Boston, Mass., is showing sample boards of Anderson overhead line material; also knife switches, time switches, charging plugs and receptacles. The exhibit is in charge of William W. Hincher.

Appleton Electric Company, Chicago, Ill., is exhibiting a number of cabinets on which are displayed "Unilets" for rigid and flexible conduit work, as well as a number of samples of outlet receptacles and switches, various types of fuses, wire connectors, outlet boxes and a complete line of telephone protective devices.

Autoelectric Sign Company, Chicago, Ill., is exhibiting its translucent art glass signs and shades, which are used for advertising purposes. This company's signs are illuminated by a single incandescent lamp. The exhibit is in charge of John Nelson and Miss Ruth Knuckey.

F. B. Badt & Company, Chicago, Ill., are exhibiting a number of Polar flaming arc lamps, and Ward Leonard rheostats.

Baker Electric Company, Cleveland, Ohio, is exhibiting one of the latest types of Baker electric vehicles. This vehicle is connected by cable to a General Electric mercury-arc rectifier charging switchboard.

Benjamin Electric Company, Chicago, Ill., has a very attractive exhibit in which are shown the various forms of tungsten arcs manufactured by the company. A number of display boards show the type and variety of the company's wireless clusters and a number of samples taken from stock show the adjustable socket clusters and the general lighting specialties which this company handles. The representatives of the company attending the electrical show are G. C. Knott, H. E. Watson, W. D. Steel and A. N. Fox.

Central Electric Company, Chicago, Ill., has its booth very artistically decorated and lighted, the general arrangement being similar to that of the company's fixture studios on Fifth Avenue. The company is showing the adaptation of "Opalux" shades for tungsten lamps. Bulletins containing a complete set of curves, which show the results of tests made on illumination efficiency and on the radiation of light where these shades are used, are being distributed. One of the new devices shown by the company is a tungstometer, which is a portable pocket instrument, intended to be inserted in any lamp socket when it is desired to obtain the wattage or ampere readings of the electric lamps that are in use. The improved Central tungstolight is being shown in comparison with other kinds of illumination. Various types of Siemens flaming arc carbons which the company has on exhibition are proving very interesting to the visitors who are interested particularly in the commercial adoption of flaming arc lamps. There is also shown at the booth a complete line of P.-M. specialties, including control switches, meter connection blocks, ground clamps and other devices which have been developed by the Price-McKinlock Company, which is a subsidiary manufacturing company controlled by the Pettingell-Andrews Company, Boston, Mass., and the Central Electric Company, of Chicago. Samples of the full line of the Central specialties, which include Okonite wires, D. & W. fuses and Pittsburgh transformers, are also shown. The following representatives of the company are in attendance: Geo. A. McKinlock, Chas. E. Brown, H. W. Young, H. M. Livor, J. E. Livor, R. L. Kimble, C. C. Dawson, F. B. Switzer, A. S. Pearl, H. Caird, J. E. Ham, J. M. Lorenz, Louis Raggio, D. C Penniman, W. D. Dunsmore and W. H. Pearl.

Chicago Fuse Wire & Manufacturing Company, Chicago, Ill., is exhibiting its well-known fuse wire, fuse links and fuse strips; a complete line of fuse cut-outs and a complete display of enclosed fuses, which includes the N. E. and old-code types, which are designed especially for any required capacity from 1 amp to 1000 amp. In addition to the standard supplies shown, the company is exhibiting its sherardized outlet boxes and covers, which are treated by a new process of galvanizing. The following representatives of the company are in attendance: A. S. Merrill, Milton Mill, W. W. Merrill, T. C. McDonald, George C. Reid, C. E. Harland and W. D. Dana.

Chicago Pneumatic Tool Company, Chicago, Ill., has on exhibition a full line of portable electric tools, including several types of electric drills, grinders, hoists, etc., for use both on direct and on alternating current. These tools are connected up and are shown in full operation. The other tools shown are the pneumatic chipping and riveting hammers and drills. The company is represented by C. B. Coates, Edward Aplin, C. W. Hayes, W. C. Walker and G. W. Walker.

Chicago Telephone Company, Chicago, Ill., has a working

exhibit of what is said to be the largest-sized multiple switchboard that was ever built. This switchboard was installed in two sections, and during the afternoon and evening sessions of the show one chief operator and six operators and supervisors were employed in making connections and answering calls. This exhibit is made to acquaint the people of Chicago with the methods employed by the Chicago Telephone Company in giving good telephone exchange service. In addition to this there is located in the booth a long-distance telephone where demonstrations of long-distance service are being given.

COLONIAL ART GLASS COMPANY, Chicago, Ill., is showing a complete line of art glass shades and domes glazed in copper and hard metal. The exhibits are attractively displayed and give the booth a pleasing appearance. The representatives present are E. C. Gmelin and Helen Bergeson.

COLLINS WIRELESS TELEPHONE COMPANY, Newark, N. J., is showing three types of wireless telephone instruments for different transmission distances; also a complete wireless telephone system for talking both ways at the same time. The principal feature is a revolving carbon arc lamp, constantly presenting new surfaces for the arc with two blow-out magnets to maintain the arc in the middle of the carbons. This permits more current being used than would be possible with the ordinary arc lamp construction and gives a more powerful system. In practice on long-distance work as high as 5000 volts are used at the lamp and for medium distances commercial 220-volt circuit is used. In this system also the sender tunes to the receiver by means of variable inductance and condenser adjusting each until perfect resonance in the transmitter circuit and perfect tuning with the receiving station is obtained, as indicated by the resonance tube burning at maximum brilliancy. This resonance tube is a long glass vacuum tube with platinum electrodes. The tuning can be adjusted for any wave length desired to suit different receiving stations, each of which would have its own individual wave length. By this method of tuning such perfect resonance can be obtained that interference from outside sources is entirely eliminated. During the show high-frequency experiments, showing the transmission of energy from the aerial, will be given. The oscillations of the human voice will be shown by a lamp connected in the transmitter circuit and shunted on the oscillatory circuit. The company is represented by A. Frederick Collins.

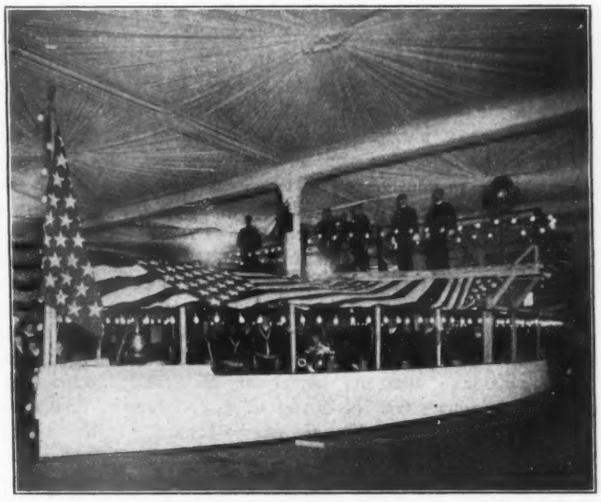
COMMERCIAL APPLIANCE COMPANY, Chicago, Ill., is exhibiting the Germless glass telephone mouthpiece which is manufactured by this company. The representatives in attendance at the booth are W. M. Wood, H. S. Conover and G. W. Conover.

CONNERSVILLE BLOWER COMPANY, Connersville, Ind., is showing the vacuum-cleaning devices which it has developed, as well as some samples of its vacuum pumps and blowers. The practical application, efficiency, capacity and utility of this company's apparatus are being demonstrated. Worth W. Preston is representing the company at the show.

CRANE COMPANY, Chicago, Ill., is exhibiting a full line of cast-steel valves and fittings for superheated steam, an electrically operated gate valve, an electric control emergency stop valve and automatic stops and checks. There is also shown at the booth Crane's pop safety and relief valves, and attention is called particularly to the Klingertt packings which this company is recommending for use with superheated steam. J. A. Minwegen is in charge of the exhibit.

CRESCENT COMPANY, Chicago, Ill., is making a feature of its Baby gasoline torch and its Harter white glass clusters. The company is also showing a line of specialties, including the Crescent soldering stick and coloring fluids and Crescent wire lamp guards, which include the Protector "O" and Protector "H" and Luxon types. The Baby torch contains no movable parts to get out of order. It is but 3 in. high and 2 in. in diameter and requires no pumping to make it ready for use. When a torch is needed all that is necessary is to touch a match to the burner and the torch is ignited. It will burn steadily for two hours from one filling of gasoline. The company is represented by A. O. Einstein, F. W. Nind, A. Meyer, J. H. McGill and A. F. W. Meyer.

CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has devoted the entire space in its booth to the display of its well-known line of push-button switches and sockets. At the entrance of the booth is located a large working model of the company's three-piece push-button switch enclosed in a plate-glass box. This switch is so arranged that when the push-button is pressed a row of incandescent lamps are lighted in the booth. The rays of light from these lamps are directed onto the company's large sign, which is located at the rear of the booth. The push-button switches are connected with numerous lamps and electroliers, which have been installed in the booth in such a way that practical demonstrations of the value of Cutler-Hammer specialties are plainly evident. A two-circuit pendant switch is shown as it should be connected with an 18-lamp electrolier. One of the buttons of this switch controls six lamps and the other button controls 12 lamps. By this method of connecting the lamps with the pendant switch, the exhibit shows the possibility of obtaining 3 deg. of illumination, consisting of 6, 12 or 18 lamps, through the operation of a single switch. Another demonstration of the efficiency of the two-circuit switch is shown by the connection of an electric fan and an electric lamp, each of which is separately controlled by different buttons of the same pendant switch. Push-button porcelain lamp sockets are also shown in connection with tungsten lamps. These are shown to demonstrate the fact that the metallic-filament lamps can be lighted and turned off without endangering the lamp by excessive jarring. Other devices shown at the booth are flush switches and electric candelabra. A number of photographs and colored drawings illustrating various applications of the Cutler-Hammer push-button specialties can also be seen at the booth. The representatives of the company in attendance are R. M. Van Vleet, R. I. Phillips, Horace L. Dawson, Charles J. Klein and H. T. James.



BATTLESHIP "ELECTRA."

DEL SALES COMPANY, Chicago, Ill., is giving practical demonstrations of the Del electric curling iron. This iron is recommended to give the Marcel-wave pompadour or other modish coiffures at a cost of less than one cent, and without injury to the hair. This iron heats from the inside and provides an even surface temperature at all times. The cord attachment of the iron can be plugged into any electric light socket. The irons are designed to be used on current from 100 volts to 125 volts. Mrs. C. A. Richards, who originated the idea of the Del iron, is in charge of the exhibit.

CYCLONE INCUBATOR COMPANY, Buffalo, N. Y., is showing a line of electric incubators, electric brooders and adaptable electric hovers. An interesting part of this exhibit is a practical demonstration of the devices, showing chickens being hatched by electricity. The heat regulation of the electric incubators is obtained by a thermostat connected in series with incandescent lamps. In the larger units electric heaters are also used. The company is represented by S. A. Smith and J. G. Porrman.

G. M. Dodge, of Valparaiso, Ind., exhibits his automatic self-teacher of telegraphy as well as his text book on telegraphy and calls attention to his institute at Valparaiso. G. M. Dodge, Brooks Conley and R. W. Elam are in charge.

Duntley Manufacturing Company, Chicago, Ill., has on exhibition four different sizes of portable electrically driven vacuum cleaners. This company's standard vacuum cleaners are equipped with chrome leather diaphragm pumps, and with a Universal ⅛-hp motor. This motor will operate on either alternating or direct current and on frequencies of from 25 to 80 cycles. The machine is contained in a double-walled metallic case, and is cylindrical in form. The vacuum developed when the pumps are in operation is from 5 in. to 8 in. with an air displacement of from 25 cu. ft. to 30 cu. ft. per minute. Each machine is equipped with 12½ ft. of hose and an electric cable 20 ft. in length and an attaching plug. By the use of an extra attachment the hose can be changed so as to utilize the exhaust of the machine for blowing the dust out of places that cannot be reached by the ordinary vacuum tools. These machines can be operated safely from any lamp socket, and are so constructed that the current consumption is not large enough to make the practice of thus attaching the machine unsafe. The company is also showing its standard vacuum sweepers, which are operated by a 1/16th-hp motor located in the machine, and which are intended only for the sweeping of floors. The company's booth is in charge of B. E. Harris, H. L. Lamphear and a competent corps of demonstrators.

Electric Appliance Company, Chicago, Ill., is exhibiting the Sangamo amp-hour meter which is designed for storage battery uses. This meter is particularly adapted for electric vehicles, for train lighting and for central-station storage battery work. It is so constructed that it indicates just how far the battery has been discharged and indicates in a backward direction while the battery is being charged so that the operator can tell by referring to the meter how well the batteries are being charged. Other apparatus shown at the booth include the Sangamo alternating-current and direct-current integrating wattmeters, Sangamo amp-hour meters, Packard tungsten lamps and transformers, Paranite rubber-covered wires and cables, Eureka massage vibrators, American Electrical Heating apparatus, Faraday signal bells and C. & S. intercommunicating telephones. The representatives of the company in attendance at the show are P. R. Boole, F. J. Alderson, F. D. Swartz, R. S. Mitten, H. M. Remington, J. K. Alline, J. B. McMullen and E. R. Field.

Electric Suction Sweeper Company, New Berlin, Ohio, is showing 12-in. and 18-in. suction sweepers for alternating-current and direct-current operation. This machine consists of a vertical enclosed motor having a centrifugal fan and revolving brush, similar to a carpet sweeper. All dust and dirt drawn up by the fan is discharged through a double silk bag, fastened over the fan orifice. This bag has an elastic neck, so that it can be easily removed for cleaning. The company is represented by S. M. Weir, T. J. Strasburger and A. W. Wasey.

Electric Storage Battery Company, Philadelphia, Pa., is showing its chloride accumulators in types D, E, F and G. These accumulators, which are shown in lead-lined and in glass tanks, are especially recommended for electric lighting, railway and telephone usage. The company is also showing a large photograph of a 10,000-amp chloride accumulator battery installation which it has recently made for the Chicago City Railway in Plymouth Court, Chicago, Ill. This battery is designed to successfully take care of the morning and evening peak loads of this railway. The company is also exhibiting accumulators for railway car lighting and railway signal and telegraph work. The batteries for the former purposes are being exhibited in the company's Manchester box and Tudor rolled combinations in both jars and lead-lined tanks. The Exide plates, which are recommended for sparking purposes for electric vehicles and for the lighting of vehicles of all types, are also shown. The company is represented by Godfrey H. Atkin, J. M. S. Waring, H. B. Marshall, F. T. Rinder, J. W. Rosholt, George Neth and H. N. Beck.

Electrical Testing Laboratories, New York, N. Y., are making daily tests of high-tension insulators, showing the method employed by the company in testing insulators intended for 100,000-volt lines. The transformer used for this test is designed for 250,000-volt current. The company is also demonstrating the intensity of the projections of arcs between magnetite pencil, flaming carbons and solid carbon electrodes, and is showing an instrument designed for the measurement of the spherical candle-power of incandescent lamps. The company has also on exhibition an instrument checking table, equipped with a potentiometer for checking up ammeters, voltmeters and wattmeters. The exhibit will be in charge of Norman D. Macdonald and Wilson S. Howell.

Electric Shoe Polisher Company, Chicago, Ill., has five of its new electric shoe polishing machines installed for use in the Coliseum Building.

Electrical World, New York, N. Y., has on exhibition at its booth samples of the *Electrical World* and of numerous technical books relating to the electric industry, all of which are published by the McGraw Publishing Company, of New York City. The company is represented at the show by J. M. Wakeman, H. T. Matthew, J. R. Cravath, E. J. Hunt, G. R. Blodgett and Louis Holstein.

Englewood Electrical Supply Company, Chicago, Ill., is exhibiting a full line of electrical novelties, including flashlights, electric cigar lighters, electric scarfpins, etc. The company is represented by L. E. Mayer, E. W. Cutler, G. I. Spinks and George A. Annable.

Excello Arc Lamp Company, New York City, is exhibiting its new 1909 Excello flaming arc lamps for both alternating current and direct current. The representatives of the company are H. M. Hirschberg, G. W. Armstrong, H. W. Towzer, T. W. Hall and W. J. Gille.

Federal Electric Company, Chicago, Ill., has its flashing signs arranged in a water-effect background, and is showing for the first time its new double reading electric signs. Other apparatus exhibited are a number of attractive tungsten cluster fixtures, Reynolds Dull flashers and various types of illuminated signs. The company is represented by J. M. Gilchrist, L. S. Shepherd, H. Lindauer and F. H. Welling.

Fort Wayne Electric Works, Fort Wayne, Ind., are exhibiting samples of their complete line of central-station equipments, including samples of their alternating-current generators, motors, arc lamps, integrating wattmeters, transformers, fan motors, etc. In addition to this display the company is making a practical display of its new "Compensarc," which is used for controlling the voltage for moving-picture machines when operated on alternating current. This "Compensarc" is a type of compensating transformer, operating similarly to a step-down transformer. This machine, which has but recently been placed on the market, when used in connection with moving-picture machines, is recommended to effect a saving in electric current consumption. It runs cool at all times, and is claimed to preclude the chance of fire resulting from overheating. This machine allows the introduction of moving-picture machines into the lighting circuit of any city without materially affecting the efficiency of the lighting service. The company is represented at the show by W. S. Goll, W. S. Hine, A. L. Pond, L. A. Carr, F. S. Wiemeyer, A. J. Francis, W. K. Eicher and H Plumley.

General Electric Company is exhibiting a full line of tungsten, tantalum and carbon-filament lamps, showing tungsten lamps of from 25 watts to 250 watts; also miniature tungsten lamps for automobile and battery service and tantalum lamps. The new 40-watt standard-size tungsten lamp and a 25-watt double-anchored filament tungsten lamp are also shown. An interesting feature of this exhibit is a photometer, with a 40-watt tungsten lamp balanced against a 32-cp carbon-filament lamp. Two type I induction integrating wattmeters, with 1-amp winding, are connected to show the relative amount of current consumption of the two lamps. These meters are arranged to give approximately full-load speed with one lamp burning. Adjoining this exhibit is a table on which are mounted two frames

suspended from an equal-arm balance. On one frame are mounted 18 25-watt tungsten lamps, using 450 watts, and giving 360 cp; on the other are 11 40-watt tungsten lamps using 440 watts and giving 352-cp. Above this balance are mounted nine 50-watt carbon-filament lamps which consume 450 watts and give 144 cp. This exhibit is to show the relative amount of illumination given by carbon-filament and tungsten lamps using approximately the same amount of current. A complete line of electric cooking and heating devices is also shown. These include electric flatirons weighing from 3 lb. to 24 lb., electric cigar lighters, percolators, radiant toasters, water heaters, air heaters, corn poppers, cereal cookers, boilers, frying pans, teakettles, stoves, ovens, gluepots, etc. Three electric kitchen combination cooking and baking outfits are shown in operation. Among the new devices shown are the 6-lb. gun-metal finish electric flatirons, similar to the 6000 irons recently purchased by the Commonwealth Edison Company, of Chicago; and an electric laundry-iron stand for use in places where a cord is objectionable. This stand will accommodate two irons, one being heated while the other is in operation. The iron to be heated is placed on an inclined plane in the center of the stand and the terminals engage two conduits in the stand, completing the circuit. Moving the iron breaks the circuit, so that no current is consumed except when the iron is being heated. Connection to this stand is made with the usual flexible cord and plug. A modified form of the electric cigar-lighter stand is shown suitable for use in stores and cafés. A new type of percolator is shown in 1½-pint, 3-pint and 4-pint sizes, which will start percolating 45 seconds after the current is turned on. The radiant toaster consists of an open-resistance frame with four vertical heating coils, and is arranged to toast two slices of bread at a time, and as the bread is held in a vertical position in the frames the objections raised to the old forms of electric toasters have been overcome. Both the percolators and the new design of water heaters are equipped with self-contained heater units. These heater units consist of a flat-ribbon resistance clamped between two mica disks, which are enclosed in a brass shell with crimped edges. A composition base on the underside of the heater unit carries the terminal pins and serves as an insulator as well as for preventing backward heat radiation. These units are interchangeable in different devices having the same current consumption, and have a lift equal to the standard cartridge unit. Several types of luminous radiators are shown, ranging from 1200-watt to 5000-watt capacities, with from four to eight heater tubes. A new mantle type of radiator is exhibited which is similar to the luminous radiator, and is arranged for permanent installation over a mantle. One of the features of this exhibit is a dry electric fountain, consisting of flashing colored lights under a pyramid of Holophane shades. The company is represented by F. H. Gale, W. H. Colman, E. L. Callahan, H. Schroeder, J. O. Case, F. T. Benson, R. E. Keller and Winifred S. Potts.

GENERAL COMPRESSED AIR & VACUUM MACHINERY COMPANY, St. Louis, Mo., shows the Thurman portable vacuum cleaning outfit for hotel and house use. The machine is operated by a ¼-hp motor and the entire equipment is mounted on a rubber-tired truck. The usual complete line of tools, including equipment for facial and body massage, is shown.

GRANT FLAMING ARC LAMP COMPANY, Chicago, Ill., is making an elaborate display of its type B alternating-current and direct-current 17-hour flaming arc lamps, and is showing the German-American Flaming Arc Company's new auto arc hanger. This latter hanger is designed for suspending arc lamps on high ceilings, and eliminates the heretofore objectionable wire loops which detract from the artistic effect of the ordinary installation of arc lamps. These hangers have already met with ready sale. Among other companies which have adopted these fixtures is the Indiana Steel Company. The Grant Flaming Arc Lamp Company is represented by H. W. Hulme and R. T. Merrick.

HAHL AUTOMATIC CLOCK COMPANY, Chicago, Ill., is exhibiting a pneumatic clock system, a program clock, a self-winding electric clock and a time stamp. The pneumatic clock system exhibited consists of a master clock of astronomical accuracy which is equipped with a self-compensating pendulum propelled by a spring automatically wound at the end of every minute. This clock is also equipped with a self-contained power device designed to operate a series of secondary clocks by alternate impulse and release of air, which is under a pressure of less than one ounce. The company is represented by Carl Mendius, H. W. Mendius, L. B. Montgomery, W. W. Billings and P. J. Hertz.

HINDE & DAUCH PAPER COMPANY, Sandusky, Ohio, has a very creditable exhibit of corrugated fiber goods, such as are used for packing lamps and other fragile articles. The representatives of the company are showing many samples of boxes made by the company in which are shipped electric lamps, lamp chimneys, lamp shades and all kinds of fragile glassware and other commodities. The company is represented by E. J. O'Hagan, E. J. Eiserman and Mr. Becker.

HURLEY MACHINE COMPANY, Chicago, Ill., is making a continuous demonstration of the Thor electric washer and reversible three-roll wringer which this company manufactures. The Thor electric washing machine is 24 in. x 25 in. in size and stands 34 in. high. The upper half of this machine is made of the best grade of red cypress and the lower half of the body, which contains the water, is made of galvanized iron with the joints and flanges brazed to make them rust proof. During the past few weeks the company has placed on the market the "Universal" joint, which fits on the flywheel of this washer and can be used on the crank of any standard electric household article that is now in use. By the use of this device ice-cream freezers, meat choppers, ironing machines, grindstones, emery wheels and many similar devices can be operated from the same motor with which the Thor electric washer and wringer is provided. The following representatives of the company are looking after the exhibit: Neil C. Hurley, B. G. Tompkins, A. J. Fisher, A. E. Carmichael, M. Y. Steen, E. J. Riedy, N. H. Haberle, Arthur Kee, Richard Ruffo, Miss A. McIver and Miss J. Erickson.

ILLINOIS ELECTRIC RENOVATOR SALES COMPANY, INC., Chicago, Ill., is showing both the commercial and the domestic sizes of Invincible Renovators for which this company is sole agent in the State of Illinois. The Invincible Renovator is not a vacuum machine. It is operated on the principle of centrifugal exhaust, and is claimed by the company to have greater power for cleaning than that of a vacuum machine. The machine is built substantially of aluminum and is mounted on 6-in. ball-bearing wheels, which allow the machine to be easily moved from one room to another. During the progress of the Electrical Show the representatives of the company are giving practical demonstrations of the efficiency of this machine.

INDICATOR ELECTRIC COMPANY, Chicago, Ill., exhibits electric clock systems, time stamps and electric clocks. In addition to this it shows sign flashers, which are claimed to do the work of many of the older types of flashers with considerably less complication. In this company's apparatus the flasher is located in the sign and requires not more than four wires from the building to the sign to operate it.

INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., are showing the text books used in several of the courses of instruction adopted for use by the schools, several volumes of books taken from the schools' technical library and a revolving globe on which are shown the many countries in which the International Correspondence Schools have students. This globe is very attractive and is made more so by a motor passenger train, in miniature, which is operated on a small track surrounding the globe. The representatives at the booth are C. C. Marson, J. E. Mellon, W. G. Jones, J. B. Hevan, V. C. Curtis and J. C. Freelove.

H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., has its booth lighted throughout by the "Linolite" system of lighting, which makes its exhibit one of the attractive features of the Electrical Show. Linolite lamps, which consist of a tube enclosing a straight filament, are arranged end to end about the booth and in front of polished reflectors which distribute the

light therefrom uniformly around the space occupied by the exhibit. This company has recently placed on the market a new line of portable desk and table lamps and picture reflectors, which are especially applicable for use with the Linolite system of lighting. This system of lighting is also being recommended for show-window purposes. The lamps used are made either with carbon or with metallized filaments in any desired candle-power. The company is also showing samples of its well-known line of "Noark" enclosed fuses, samples from a new and complete line of National Electrical Code standard service switch fuse boxes which are equipped with interchangeable conduit fittings, making them suitable for any form of installation. These boxes are made in capacities up to 400 amp for service on current ranging from 250 volts to 600 volts. The J.-M. catenary line construction material is also given an important place in the booth. These materials include a complete line of porcelain strain insulators, steady braces, messenger insulators, bracket arms, anchors, pull-off clamps, studs and hangers, etc., for line constructions, intended for carrying current ranging up to 11,000 volts. Various sized J.-M. immovable guy anchors are being demonstrated. This type of anchor is so constructed that the disks of which it is made can be expanded to nearly twice their original extreme diameter, and it is claimed the anchor can be installed in much less time than is required to install other types of anchors. Other Johns-Manville materials shown at the booth are Moulded Mica overhead line material and fittings for low- and high-tension railway work, vulcabeston and other molded insulating compounds, Noark fuses, Jomanco friction tape and many samples taken from the stock of standard supplies for railway, lighting and telephone construction and maintenance work. The following representatives of the company are attending the show: T. G. Younglove, H. M. Frantz, J. C. Younglove, H. W. Frantz, F. G. Simpson, T. T. Lyman, G. A. Saylor, J. C. Cone, F. C. Frumveller, T. H. Bailey and J. W. Perry.

Kellogg Switchboard & Supply Company, Chicago, Ill., has on exhibition a train dispatchers' outfit which this company is recommending for the use of the dispatching of trains on steam railroads. The system as shown includes the dispatchers' master set and four substation sets which are arranged into a working exhibit. By the use of this outfit it is claimed the dispatcher has full control of his wires at all times and can select any one station on the line or ring any desired number of stations by one operation. The company has also provided a waiting room set to demonstrate the value of installing a telephone in the waiting room of way-stations, which enables the trainman in the absence of the operator to communicate directly with the train dispatcher. This system is intended to show the superiority of the telephone over the telegraph for the safe operation of trains. The telephone apparatus shown is of the same type as has been ordered by many of the transcontinental railroads for adoption on their lines. At the exhibit is also shown a Jennings iron pole telephone set which is designed to be placed on a pole at any desired point for the use of trainmen. A trainmen's telephone, which is intended for allowing conversation to be held between trainmen inside of a car and the dispatcher is also shown. When this type of apparatus is used it is necessary to make connection to the main telephone wires by the aid of a specially devised apparatus which hooks over the main wires and forms a loop with the telephone set at the bottom end. Other apparatus on exhibit are the new railway wall and portable composite sets, which are designed for use on telegraph wires simultaneous with the dispatching of messages by telegraph; desk and wall types of intercommunicating sets for use in warehouses, factories, etc.; test sets and other equipment especially designed for railway service. The representatives of the company in attendance at the booth are J. E. Kelsey, A. Wray and W. P. Booth.

Charles L. Kiewert Company, Milwaukee, Wis., is exhibiting "Alba" and "Aurola" flaming arc lamps. The company has three of the former on exhibit connected in series, each lamp giving 1800 mean hemispherical candle-power. The maximum candle-power of the Alba lamp is about 30 deg. from the horizontal, and the distribution of light makes it suitable for lighting large areas, such as assembly halls, machine shops, railroad shops, switching yards, and for economical yet brilliant street lighting. The Alba lamp employs vertical carbons. The Aurola lamp is of the well-known inclined carbon type, the construction and design conforming to modern types of flaming arcs. The feed employs one flat-link chain of unusual design and only one wheel. Some of its additional features are: Separated control for feed, sensitive arc distance adjustment, positive automatic cut-out, sliding guide of negative carbon of simple design. Both of these lamps are shown for the first time in Chicago, and are attracting considerable attention. The exhibit adjoins that of the Central Electric Company. The company is represented by K. A. Albrecht.

Kirkpatrick Conduit Company, Chicago, Ill., occupies the booth with the Grant Flaming Arc Lamp Company, and is showing samples of its clay conduits, which are made in multiple and single ducts. These conduits are recommended for every kind of underground installation. The company is represented by E. F. Kirkpatrick.

A. W. Kratz, Chicago, Ill., is showing the "1900" electric washer with a wringer attachment and a clothes wringer designed to be attached to a stationary washtub for use in rinsing clothes. The washing machines with the wringer attachments are operated by a single ⅛-hp motor. The exhibit is designed to show how economically this apparatus can be operated. The exhibit is in charge of A. W. Kratz.

Lindstrom, Smith Company, Chicago, Ill., is exhibiting an attractive assortment of White Cross electric vibrators and electric specialties. This exhibit includes the White Cross electric hair drier and adjustable clamps. The clamps are designed for holding the drier into position on any type of chair or table, to make the work of drying the hair less tedious. There is also shown at the booth electric vibrators which operate by dry-cell battery and others that operate either on direct or alternating current, and the company's No. 18 vibrator which can be operated by dry-cell battery or by either direct or alternating current. Other devices shown are the physicians' White Cross combined galvanic and faradic batteries; also a line of therapeutic lamps for medical purposes, bleaching, etc.

Manhattan Electrical Supply Company, Chicago, Ill., is exhibiting the Gem vibrator. It also is showing dashboard and marine spark coils and heating devices as well as dry batteries. The exhibit is in charge of A. C. Holland, Clark Methot and Dr. H. T. Bassett.

Matthias Klein & Sons, Chicago, Ill., is exhibiting a full line of Klein products for electric transmission line construction and maintenance, as well as tools of general utility for electricians and for lighting, power and traction men. This exhibit comprises a very wide variety of tools such a climbers, splicing clamps and plyers of many different types. This company claims to be the pioneer manufacturer of tools and supplies used in the construction of electric transmission lines.

McRoy Clay Works, Brazil, Ind., is showing a complete line of salt glazed vitrified clay conduits in single and multiple duct types. In addition to the standard 3¼-in. conduits, the exhibit includes a special 2½-in. duct, which is a sample of a supply made for use on the Pacific coast. This type of conduit is being recommended by the company for the use of central stations and street railways.

Mears Ear Phone Company, New York City. is showing its aurophone, which is an improved electrical device that the company is recommending for the use of people who have defective hearing. This device has quite a record as a reliable sound magnifier and is so small in size that it can be carried unnoticed in a person's pocket. The exhibit is in charge of John S. Linde and a corps of able assistants.

Mechanical Appliance Company, Milwaukee, Wis., has on exhibit an electric flour sterilizer and ager which it has built for the use of the Alsop Process Company. This sterilizer consists of an iron box containing revolving rollers which are connected to a high-pressure spark coil. Current for this coil is provided by a 500-volt generator which is located on top of the

sterilizer. A current of air is provided in this sterilizer for blowing out the arc and carrying off the gases which are formed by the arc. These gases age and sterilize the flour by passing up through it. The company is also showing several direct-current motors of both variable and constant speeds and of the horizontal and vertical types; also three-phase, alternating-current motors and self-starting single-phase motors. The motors exhibited are connected up to the feed wires leading into the Coliseum and are operated when desired. The company has just brought out an electrically operated crossing gate which has been erected at the booth as a working exhibit. This gate is operated by a small direct-current motor which is driven by 500-volt current. It is so designed that the arms of the gate can be raised or lowered from a single tower or from any desired point, simply by the opening and the closing of a switch. The company is represented at the show by J. G. Zimmerman, R. G. Kellogg and H. H. Ford.

MECHANICAL & ELECTRICAL MANUFACTURING COMPANY, Chicago, Ill., shows a line of electrical porcelain goods, including porcelain receptacles and weatherproof sockets, outlet-box covers, etc. Wm. Burmeister, H. Hargis and Albert Maier have charge of the booth.

MILWAUKEE VACUUM MACHINERY COMPANY, Milwaukee, Wis, is showing two Milwaukee portable vacuum cleaners. These machines are each composed of a triplex vacuum pump, direct-connected to a ¼-hp motor, and mounted on a small three-wheel truck. Three dust collecting cylinders are also mounted on the truck so that they are easily accessible for cleaning. The outfit can be connected by a flexible cord to any lamp socket, and is made for either alternating-current or direct-current circuits. This company also exhibits a complete line of various cleaning tools suitable for carpets, draperies, upholstery, matresses, etc. The company is represented by W. H. Cameron, A. F. Seaman and Sutherland & Carpenter, Chicago representatives.

MONARCH VIBRATOR COMPANY, Chicago, Ill., is exhibiting its complete line of Monarch electrical massage vibrators. Two of the types of vibrators manufactured by this company are operated by electricity and one of the types is operated by dry-cell batteries. The company has perfected its No. 3 vibrator so that it can be operated on either direct or alternating current without the intervention of an electric light bulb, as has heretofore been necessary. The representatives of the company are demonstrating the efficiency of the motors used in the Monarch machines. These motors are of the bi-polar type, and produce 15,000 vibrations per minute. The speed of the motor is controlled by a special adjustment device which makes it possible to produce 70 different vibratory strokes.

MURPHY ELECTRICITY RECTIFIER COMPANY, Rochester, N. Y., is exhibiting its rectifier for changing alternating into direct current. The machine consists of a rotary disk type of rectifier, driven by a small synchronous motor, and is designed to do away with inductances, resistances, vacuum tubes and chemicals. It is intended for charging storage batteries for series arc lighting for X-ray and other electro-medical appliances, for moving picture machines, for electroplating, telephone, telegraph, fire alarm and signaling systems. With this type of rectifier the losses are constant, so that the efficiency increases with the load. By the use of an entirely novel principle of control it is possible to regulate the current very closely, making this rectifier applicable to purposes hitherto believed impossible, where close regulation is necessary. The company is represented by Thomas J. Murphy, Richard Murphy and James P. B. Duffy.

NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, Ohio, has an exhibit consisting of one Acme automatic multiple-spindle screw machine. This machine, which is motor-driven, is shown in operation manufacturing small brass coupling joints with internal and external threads which are made by a single operation by the machine. The company has also on display a sample board showing several of the types of work which can be done economically by this machine. Photographs of the various types of Acme automatic machines that the company manufactures, together with a few of the attachments to be used on the machines when special work is required, are shown. The exhibit is in charge of E. C. Woolger and A. D. Breeze.

NATIONAL BATTERY COMPANY, Buffalo, N. Y., has on display at its booth a board containing sample grids, plates and other material used in connection with the manufacture of all types of its battery plates for ignition, propulsion, light, power, telephone, signal and fire alarm uses. The exhibit consists of a very comprehensive display of the various materials used in the manufacture of storage batteries for every purpose. The company is represented by E. B. Cottrill, Bertram Smith, A. Otto Hiester, W. F. Daner and W. W. Somes.

NATIONAL ELECTRIC LAMP ASSOCIATION, Engineering Department, Cleveland, Ohio, has its booth decorated with all of its latest and standard styles of Gem, tantalum and tungsten incandescent lamps. The booth is surrounded by arches in which are set tungsten lamps in high-efficiency holophane reflectors. The arches were designed to conform in general appearance with the other decorations in the Coliseum. The special feature of the exhibit is a display of materials of which the tungsten lamp is made. A glass case is provided in which the minerals and chemicals which are used in the making of the finished lamp are shown, and an exhibition table is provided upon which are located meters designed to show the increased efficiency of the tungsten over carbon and tantalum lamps. At another table in the booth demonstrations of the better regulation of the voltage candle-power of tungsten lamps are given. Practical demonstrations of the use of tungsten lamps for show-window illumination are made, as well as demonstrations showing the superiority and the efficiency of tungsten lamps over carbon-filament lamps. The exhibit is in charge of P. F. Bauder, R. B. Clark and R. F. Strickland.

NATIONAL CARBON COMPANY, Cleveland, Ohio, is showing samples of its carbon products for flaming, open and enclosed arc lamps, carbon electrodes for electric telephone work, carbon crucibles and carbons for motion-picture machines. The company is also showing a general line of motor and generator carbon brushes, and is displaying panels of carbon specialties for telephone apparatus and many of its other well-known products. The company is represented by N. C. Cotabish, A. J. Summerell, Wallace O'Connor and A. V. Ward.

THE U. S. NAVY EXHIBIT, which occupies the entire Coliseum Annex, is one of the attractive and instructive exhibits of the show. The exhibit is in charge of Chief Gunner Andrew Olsson, U. S. N., who is also assistant in charge of the U. S. Navy Electrical School, Navy Yard, New York. He is assisted by chief electrician, J. Munroe; electrician, first class, A. M. Minoot; electrician, second class, B. H. Goldsboro, and electrician, third class, W. D. Wickney, all of which are graduates or students of the Navy Electrical School. The walls of the Annex are very artistically decorated with large United States flags and emblems, and red, white and blue bunting. The ceiling is draped with bunting and lighted so as to give an appearance of height to the room. The main part of the exhibit consists of a model of a battleship which has an extreme length of 78 ft. and a beam of 21 ft. The deck of this model is equipped with many of the fixtures found on the main deck of a battleship. It has two 6-lb. Hotchkiss guns, two 1-lb. Hotchkiss guns, two Colt automatic firing guns, two gatling guns and one 3-in. fieldpiece. The bridge, which has been constructed so that the visitors can pass over it, is equipped with searchlights, night signal keyboards, truck light controllers and other electric devices which are usually found on a model battleship, such as helm anchor indicators, revolution telegraphs, steering telegraph apparatus, compass, binnacle wheel, etc. The model battleship is equipped with electric semaphore lights and a complete wireless telegraph system on which practical demonstrations of the sending and receiving of messages by wireless are given. The auxiliary receiving and sending station is located in the far end of the main room of the Coliseum. The canopy covering the decks of the model ship is surrounded by 500 8-cp electric lamps, which

add very materially to the attractiveness of the exhibit. At one side of the Annex the navy has on display the wiring diagrams of all of the principal electrical installations used on the United States battleship *Connecticut*, as well as literature and diagrams of the following wireless telegraph systems: Shumaker, Telefunken, De Forrest, Mossie, Fessenden, Stone and Pickard; also diagrams of navy standard switch and distribution boards for all purposes. At the west side of the Annex several glass showcases filled with relics of the Spanish-American War are exhibited. These were furnished for the occasion by Mrs. Stickney. On the south side are shown moving pictures taken of the Atlantic fleet on its cruise around the world, also many biographical views on land and sea as taken from several of the United States battleships. A very complete exhibit of the U. S. Hydrographic Office, showing charts, maps, etc., also occupies a portion of this part of the building. During the progress of the Electrical Show, Mr. Olsson and his assistants are explaining in detail the various courses taught at the U. S. Navy Electrical School and are explaining the attractive features of service in the U. S. Navy.

Henry Newgard & Company, Chicago, Ill., is showing the Newgard waterproof receptacle mounted on a fountain with running water spraying over it. The company is also showing the Wizard medical battery and several of its electrical specialties, such as panel boards and steel cut-out boxes which it manufactures. This company had complete charge of the wiring of the Coliseum for the Electrical Show and aided in designing the electrical effects of the main show room. The company is represented by Henry Newgard, Martin Newgard and Dr. A. S. Goss.

Chris. S. Neville Company, Chicago, is exhibiting three Neville illuminating signs, two of which are circular in shape, illuminated by one cluster, and the third, oblong in shape, is 12 ft. x 5 ft. and is illuminated by two clusters. Each of the clusters consists of three concealed lamps in connected diffusers, so that the illumination is evenly distributed over the surface of the sign. The company is represented by Chris. S. Neville, J. C. Sternburger and Joseph B. Tinker.

Northern Electrical Manufacturing Company, Madison, Wis., is showing a number of samples of equipments of the company's manufacture, among which is a Northern Electric rock drill which is shown in actual operation. This drill is operated by electric power which is transmitted from the motor to a revolving helve in which are mounted two hammers which are so placed that they are thrown by centrifugal force outside of the diameter of the helve. The hammers impinge on a simple steel device which serves both as a piston and a chuck for the drill. The hammers are cushioned on air. There is also shown at the booth a Northern, type S motor which has a laminated field. These laminations are of horseshoe shape, and are assembled in such a way that each end of the horseshoe forms an internal pole tip as well as one-half of the pole piece. This is said to be the most effective method of controlling the lines of force and is said to be successful with the motor running under heavy overloads as well as under wide ranges of speed and reversal. These motors are constructed for enclosed operation, and are so arranged that the commutator and brush rigging are easily accessible at all times. They are especially designed for driving machine tools. Other devices shown at the company's booth is an Atwood vacuum cleaning outfit, driven by a Northern type B motor, Northern type S grinders and a type S buffer.

The North Shore Electric Company, which gives central-station service in the suburban towns surrounding Chicago, made as the great feature of its exhibit an array of Pacific electric irons of the kind which it is loaning free to customers. Another important feature of the exhibit was the meter-testing board, which contained a Fort Wayne wattmeter of the kind used by the North Shore Electric Company with different candle-powers of lamps which could be easily connected and show how the speed of the meter varied according to the load. Along with this was an ammeter which was calibrated to read in cents per hour instead of kilowatt-hours. Mr. John G. Learned, contract agent of the North Shore Electric Company, and his various assistants, were in charge.

Oral & Motion Advertising Company, Chicago, Ill., is exhibiting a machine for advertising purposes which consists of moving advertising panels and a phonograph which operate in conjunction from current supplied by one motor. L. S. Treat is in charge of the exhibit.

Pacific Electric Heating Company, Ontario, Cal., is exhibiting its various types of electric flatirons and toasters. The principal feature of this exhibit is the company's new automatic cut-out attachment which it has recently placed on the market. This attachment is entirely mechanical, and may be attached to any of the company's well-known "hot point" irons. It consists of a small conical-shaped well which is filled with a metal which softens with excessive heat. In this well is placed a spiral-shaped metal spindle. This spindle is held rigidly in one position between the heating units until the iron is subjected to excessive heat, when it is allowed to turn. The spindle upon turning releases a spring which is attached to the upper portion of the iron and the spring in turn engages with the lower portion of the connecting switch plug and throws the plug entirely out of the socket, thus eliminating the danger of the iron burning out. It is attracting a great deal of the attention of visitors at the company's booth. All of the Pacific Electric Heating Company's 1909 irons will be provided with these automatic cut-out attachments. This company's large pressing and tailor irons, in which the heat may be adjusted to three distinct temperatures, are also being shown. Several of the automatic cut-out irons on exhibition have been in constant operation under very severe conditions for the past six months, and have shown no deterioration whatever. The Eltosto, which was one of the first electric toasters to be placed on the market, has been given a conspicuous space in the booth. This toaster is built with an open coil which prevents it from reaching a temperature high enough to cause oxidation. The electric curling tong heater manufactured by this company has a cord attachment which screws into an ordinary electric light socket. It consumes less than 1 amp of current in heating. Other devices shown are electric air heaters, foot warmers, chafing dishes and percolators. This company has recently opened up a new factory in Chicago, where all of the electric devices sold in the Central and Eastern States will be manufactured. The company is represented at the show by H. F. Holland, J. R. Richardson, W. L. Gender, Miss Lucy Black and Miss Gladys Lee.

Palm Engineering Company, Detroit, Mich., is exhibiting its various types of vacuum cleaning machinery. The vacuum pumps with which this company's machinery is equipped is especially designed to handle dust-laden air. It is claimed the pumps are so constructed that dust strainers in the form of buckets, water separators, etc., are eliminated without reducing the efficiency of the pumps, and thereby prevent the friction which is often caused by tight-fitting piston rings in some forms of vacuum pumps. The packing for the Palm Engineering Company's vacuum cleaning machinery is of the constant flowing water type which is designed to obviate the necessity of constant lubrication and care. The company claims that ½ hp is sufficient to operate its vacuum pumps efficiently.

Peerless Light Company, Chicago, Ill., has on exhibition samples of its complete line of gas and electric lamps and art glass shades. The company is also showing a new type of Peerless gas lamp and a new electric sign. The exhibit is in charge of William Herskovitz, Robert Witz, L. Landesman, Abraham Herskovitz, Max Herskovitz, J. G. Shonfarber, Arthur Davidson, Ben. F. Henshel and Milton Zucker.

Pelouze Electric Heater Company, Chicago, Ill., has a working exhibit of the Universal electric sadirons. The irons made by this company are in 4-lb., 6½-lb. and 8½-lb. sizes. The Universal iron is a new product that has just been placed on the market. The iron is made of three separate units, consisting of a handle and frame, a heater unit and an ironing face, all of which are held together by a single bolt. The heater unit is composed of a flat ribbon wound on edge and

embedded in a special heat-resisting insulating compound of extreme rigidity. By employing this method of winding, all parts of the heater unit are brought in close proximity to the ironing face and increased heat radiating surface is given at the point of the iron where the greatest heat is required. The main parts of these three different sized irons are interchangeable. At the beginning of the show this company turned the current on one of its irons and has determined to leave the iron connected up until the show closes. This is done to show the practical indestructibility of the irons and to show the distribution of heat at the bottom of the main casting. The exhibit is under the charge of Wm. Nelson Pelouze and Chas. P. Madsen.

PERFECTION VACUUM CLEANER COMPANY, Chicago, Ill., is making daily practical demonstrations of its portable and stationary types of alternating-current vacuum cleaners. The portable type of cleaner is mounted on a three-wheeled rubber-tired truck and is encased in a neat oak-paneled case which is provided with a handle to aid the user in moving it from place to place. The stationary type of cleaner is very compact in form. These machines are capable of producing from 15 in. to 20 in. of vacuum and are each operated with a 1-hp motor. The members of the firm in attendance at the show are O. E. Becker, J. L. Wallace and Harvey Wallace.

PHOENIX GLASS COMPANY, Pittsburgh, Pa., and New York, is showing Phoenix inner and outer globes and shades for incandescent lamps. Also new tungsten, colonial and cut-glass reflectors, and many other attractive lighting reflectors.

RED CROSS ANTISEPTIC COMPANY, Chicago, Ill., is exhibiting the Red Cross antiseptic telephone mouthpiece, which is made of vulcanite with an inner lining of perforated aluminum. The interior periphery of this lining is turned backward so as to form a hollow rim, which is filled with absorbent material saturated with Red Cross antiseptic fluid. The mouthpiece has been indorsed by many medical authorities. The booth is in charge of Aaron Levitt and Lester D. Fried.

ROBBINS & MEYERS COMPANY, Springfield, Ohio, is showing motors ranging in capacity from 1/50th to 15 hp, which are designed to drive most any type of machine. One application of this motor is shown by it driving a press made by the Buffum Tool Company, of Louisiana, Mo. This exhibit is made for the dual purpose of showing the efficiency of the motor and of demonstrating the value of the press. The Standard motor is also shown in connection with a Thomas & Smith pump. The motor is shown in operation at the bottom of a tank filled with water. The Ilg Electric Ventilating Company is demonstrating at this booth the value of its ventilating shutters when used in connection with an exhaust fan operated by Standard motors. Another unusual exhibit is a motor driving a sewing machine, the current for which is controlled by the foot treadle of the machine. This device can be applied to any type of sewing machine without the aid of an electrician. The company is also showing the Robbins & Meyers electric hoist, which is intended for the use of manufacturers and dealers whose places of business are not provided with freight elevators for conveying goods between the different floors of the building. Other devices shown at the booth are various types of grinders and buffers and a complete line of fans. The company is represented by H. A. Porter, J. F. Kadic, F. P. Luedtke, E. C. Starr, R. A. Ilg, F. W. Batterman, A. C. Durdin, M. R. Weil, R. C. Burmood, C. F. McGilvray, H. E. Myers and W. W. Mumma.

ROTH BROTHERS, Chicago, Ill., show a full line of direct-current motors, air compressors and blowers, as well as one of their vertical direct-current motors and some buffing and grinding motors. They also exhibit a motor and controller for printing presses. In this booth also is shown the Economy automatic water system, which furnishes water without the use of a roof tank for buildings where the city pressure is inadequate. The Economy submergible bilge pump is also shown here. These pumps discharge into the sewer from basements which are below the sewer level. The motor is claimed to operate under most adverse conditions, even that of being 10 ft. to 15 ft. under water.

SHELTON ELECTRIC COMPANY, Chicago, Ill., is exhibiting at its booth a complete line of the Shelton vibrators and vibrator accessories. The Shelton devices include several notable improvements over what has ever before been shown. Among the most recent vibrator attachments which this company has placed on the market is the Shelton electrical razor, which is designed to be used in connection with the Twentieth Century vibrator. This razor has a weight of about 3½ oz. Inside of the handle of the razor is located a rotary eccentric which gives the blade a vibratory movement sufficient to cut the hair as the blade is drawn down across the beard. The razor is similar in design to the ordinary safety razor. Other new devices shown are the Shelton vibro hand massage instrument, which is designed especially for the use of osteopathic physicians, and the Shelton Marcel vibrator, which is manufactured expressly for manicurists and for use in hairdressing parlors. The company is giving continuous demonstrations of the various vibrator instruments which it manufactures.

SIMPLEX ELECTRIC HEATING COMPANY, Cambridge, Mass., is showing a complete line of electric-heating appliances, including a number not heretofore shown. Among these are a circulation water heater, which may be attached to any kitchen or range tank; a special glue pot for use by cabinet makers; special designs of food warmers and a complete line of chafing dishes, percolators, teakettles and various sizes of range and cooking combinations. During the progress of the show Mrs. Gans, a domestic science expert, gave practical demonstrations of cooking by electricity. Practical demonstrations of ironing by electricity were also made. The company was represented by H. R. Hixson, J. N. Macalister, J. G. Brobeck, W. F. Hruby, George Plachek, James De Han and E. R. Jacobs.

STANDARD VACUUM CLEANER COMPANY, Chicago, Ill., is exhibiting a line of portable vacuum cleaning apparatus of convenient type which may be carried about in the hand. The entire outfit is enclosed in a cylindrical metal case measuring 10 in. x 18 in. It is operated by a universal motor of 1/6 hp, which is enclosed in the case. The booth is in charge of A. H. Lanphear, assisted by George Clements and C. W. Hayes.

STOLTZ ELECTROPHONE COMPANY, Chicago, Ill., is showing the Stoltz electrophone, which is a sensitive portable telephone which enables deaf people to hear ordinary conversation. The Stoltz opera and church electrophones and the Stoltz stenographone are also exhibited. This latter type of apparatus is used in letter dictation and for communication between rooms. It is designed for the use of busy men, who by its aid can sit at their own desk and dictate letters to a stenographer in another room.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., has an exhibit of the telephone apparatus manufactured by the company, which includes the various types of generator call and central-energy instruments for different kinds of service. Two prominent displays of this exhibit are mounted on panels, which form the background of the booth. One of the panels, completely wired and ready for operation, is devoted to the company's new line of central-station intercommunicating telephone systems. The other panel is arranged to display a complete equipment of the company's selective alarm railway telephone dispatching system, and includes the dispatcher's office equipment and several local station equipments with telephone instruments and semaphore signals connected. This exhibit is completely wired and shown in operation for demonstrating purposes. Two hexagonal revolving display turrets are located in the booth upon which are mounted various types of telephones. On one of these turrets are located generator-call telephones and on the other are located central-energy telephones. These displays are such as are used for rural telephone operation and for general office and house installations. In addition to these the company is showing several types of magneto and common battery switchboards of the smaller types, including the self-restoring gravity drop magneto switchboard and a lamp-line private branch switchboard. All of these exhibits are wired and connected up so that they may be rung intermittently to attract the attention of visitors passing the booth. The representatives of the company in attendance are A. M. Haubrich, H. C. Slemin and Ben C. Hyde.

Swedish Electric Vibrator Company, Chicago, Ill., is showing a complete line of electric massage vibrators of both the current and battery types. Special attention is being called to the motor vibrator, which weighs but 24 oz. This vibrator will operate equally well on direct or alternating 110 or 120-volt, 60-cycle current, with practically no vibration in the handle. It has a brush-shifting device for regulating from high to low speed. The vibrator is sold in a portable case containing six different applications, with a complete equipment of accessory apparatus. The company's booth is in charge of professional lady attendants, giving practical demonstrations of the devices.

Swedish-American Telephone Company, Chicago, Ill., has on display at its booth samples of its exchange telephones, switchboards, telephone tables and many samples of the parts which are used in the manufacture of its telephone apparatus. Among the new apparatus brought out by this company is a desk telephone rigidly mounted on the top of a small mission table, with a small mission stool to match. The auxiliary apparatus for this telephone is mounted on the under side of the hinged top of the table, so as to be readily accessible. When the stool is not in use it can be pushed in underneath the table, and in this position is held clear of the floor by guides. The representatives at the booth are calling attention to the fact that the company is building a new telephone-manufacturing plant at Waterford, Ont., where telephone apparatus sold in Canada will hereafter be manufactured. This building, which is to be 60 ft. x 250 ft. in size and two stories high, will be ready for operation about March 1. The representatives of the company at the Electrical Show are E. B. Overshiner, O. V. Overshiner, W. O. Rhode and Fred Seeley.

Taussig & Babcock, Chicago, Ill., are showing a small Kerr turbine direct-connected to a 5-kw Burke generator, as well as a switchboard on which is mounted a number of American intruments. They are also showing a special generator designed for furnishing electric light and spark-ignition for automobiles. This generator is designed to be geared to an automobile engine in the same way that a magneto is usually attached and delivers constant current within limiting speeds. Other devices shown by the company are a Warner friction clutch of the constrictor type, Condit circuit-breakers and samples of the Automatic Switch Company's motor-controlling apparatus. F. R. Babcock, Mr. Taussig and P. R. Fisher are in attendance.

Thomas & Smith, Chicago, Ill., is exhibiting in a part of the booth occupied by Roth Brothers an automatic electric water system. This system consists of a two-stage centrifugal pump direct-connected to a Roth electric motor, a steel compression tank and an automatic controlling switch. The system is devised for furnishing water automatically to buildings without the ordinary roof tank. M. I. Weil represents the company.

Thordarson Electric Manufacturing Company is exhibiting electric laboratory appliances, bell-ringing transformers and small transformers for operating electric signs; also induction coils and automobile and stationary gas and gasoline engine coils. A full line of electrical toys is also exhibited. These toys are operated by small transformers. The booth is in charge of C. H. Thordarson, assisted by John Beenan and A. J. Johnson.

United Pump & Power Company, Chicago, Ill., is showing two complete installations of the Perry pneumatic water system. One of these installations consists of a No. 14 Perry pneumatic pump, installed in an open tank, which is meant to represent a well. In connection with this installation is a 300-gal. air storage tank. The air for this tank is supplied by a single-acting 6-in. x 6-in. "Granite" compressor, driven with a 3-hp Wagner electric motor. This motor is started and stopped automatically by a Perry automatic controller, patents on which have but recently been granted. The controller is connected with a starting box which throws the motor in circuit and leaves it so until a desired pressure is secured in the tank, when the motor is automatically stopped. The other exhibit shown is a No. 6 Perry pneumatic pump. This pump is installed in a glass tank in such a way that its operation can be plainly seen from the outside. The air tank has a capacity of 100 gal., the air being supplied by a double-cylinder Perry air compressor which is driven by a ½-hp Wagner motor. The company is represented at the show by Mr. Thomas O. Perry, Mr. George C. Huppertz and Mr. L. S. Landis.

Vulcan Electric Heating Company, Chicago, Ill., is exhibiting its full line of soldering and branding irons and curling irons. The object of this company has been constant perfection of its present line of apparatus. F. J. Holmes, W. J. Miskella and W. M. Williams are in charge of the exhibit.

Wagner Electric Manufacturing Company, St. Louis, Mo., is exhibiting for the first time its latest model of a single-phase alternating-current motor, and also one of its latest models of polyphase alternating-current motors. The company also is showing samples from its complete line of various types of alternating- and direct-current instruments, including its ammeters, voltmeters, power-factor meters and wattmeters in direct and alternating current. The instruments manufactured by this company are made in almost any desired type. There is also on exhibition a flaming arc-lamp transformer which is designed for installations of single flaming-arc lamps on 110-volt direct-current circuits. The booth is in charge of F. N. Jewett, C. B. Richardson and C. C. Warner. W. Robbins and W. A. Layman, of the company, are occasional visitors to the exhibit.

Western Insulation Company, Chicago, Ill., is exhibiting at its booth, mica manufactured into commutator rings, commutator bars and segments, mica tubes, and a general supply of mica for insulation purposes as manufactured by the Chicago Mica Company, of Valparaiso, Ind. The company will also show the raw mica products of Watson Brothers, Boston, Mass., and the insulating cloths, papers, tapes, etc., of the Irvington Varnish & Insulation Company, of Irvington, N. J., and samples of the fibro products of the Wilmington Fiber Specialty Company, of Wilmington, Del. The company is represented by F. T. Finney, E. M. King and A. R. McNally.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has an exhibit which includes several of its new line of shell type distributing transformers. These transformers are of approved design and are manufactured from a high grade of alloy steel. The line shown includes transformers of from 1- to 50-kw capacity, and are designed to be used on current having a frequency of from 50 to 133 cycles. Demonstrations are made on a small transformer which shows the assembled coils. The company also has on exhibition samples from its line of electric flatirons, which are designed for every class of work. Samples of small fans for telephone booths and fans designed for most every other desired purpose are being shown. Special attention is called to the company's new line of luminous and non-luminous electric-heating coils, and to its electric glue pots and chocolate warmers, the latter being intended for the use of confectioners. In addition to this, the company is showing a line of small horse-power motors for use on direct and alternating current. These motors are for use on sewing machines and jewelers' buffing machines and for many other similar purposes. The company is also showing small power motors, ranging in capacity from 1/20th to ¼ hp each; also a new type of single-phase motor which is built in capacities up to 5 hp, and several types of polyphase induction motors which in stock range from one up to any horse-power desired. Other devices shown are a number of direct-current motors, motor-starting devices, battery-charging outfits and metallic flame and other types of arc lamps. The company is represented at the show by T. P. Gaylord, E. M. Bischoff, J. W. Busch, H. H. Caughlin, Stephen Gardner, Ivan Hennings, W. D. McDonald, Malcolm McNeil, A. L. Millard, A. M. Miller, R. H. Moore, S. G. Peticolas, W. R. Pinckard, C. W. Regester, R. F. Schaulin, J. M. Schilling, Charles Talbott, J. W. Lewis, C. B. Humphrey, G. B. Griffin, S. L. Nicholson, C. S. Cook, J. C. McQuiston, C. C. Chappelle.

Weinsheimer Company, Chicago, is showing two 10-watt flaming-arc lamps connected in series and operating on 110 volts; also one alternating-current and one direct-current lamp exposed to show the mechanism. This company is also exhibiting the Roller Smith Company's air-brake circuit-breaker and a Hartman three-pole oil circuit-breaker. The company is represented by W. E. Weinsheimer, Edgar Switzer and A. P. O'Hara.

WESTERN ELECTRIC COMPANY, Chicago and New York, is showing a representative line of common battery and magneto telephone apparatus, including desk and wall instruments, coin collecting boxes, bells, howlers, condensers, telephone protectors, etc. Several different styles of intercommunicating telephones suitable for interior systems and isolated plants are exhibited; also a number of special telephone sets, including railway composite sets, linemen's test sets, U. S. Navy battleship telephones and also iron box telephone stations, as furnished for the City of New York High Pressure Fire Service Telephone System, and the U. S. Life Saving Service. On one side of the booth telephone systems suitable for railway train dispatching are shown, including Gill and Wray and Cummings selectors and station machines, train dispatcher's telephone sets and instruments for station agents and tower men's use. The company is represented by C. H. Starkweather, Jr., W. H. Tompkins, J. H. Finley and C. L. Howk.

Automatic Thermal Cut-Out for Electric Flatirons.

The Pacific Electric Heating Company, Ontario, Cal., is exhibiting at the Chicago Electrical Show for the first time its improved automatic cut-out electric flatiron. The iron is substantially the same as that the company has been manufacturing for the last five years, with the exception of an automatic cut-out device, which can be applied to any of the irons that have been made by the company. The automatic feature is entirely mechanical. In the space between the heating units at the back part of the iron there is located a small perforation containing a metal which softens with excessive heat and also a spiral-shaped metal spindle. When the iron overheats the metal in the well softens, allowing the spindle to revolve, thereby releasing a spring, attached to the upper portion of the iron

AUTOMATIC THERMAL CUT-OUT FOR ELECTRIC FLATIRONS.

just under the handle, which disconnects the current from the iron by throwing the switch plug entirely out of the socket. The spring is thoroughly insulated with asbestos from the lower portion of the iron, so that it cannot, it is claimed, get hot enough ever to cause it to lose its tension. To replace the switch plug it is necessary to use considerable pressure. The spring re-engages with the spindle as soon as the metal in the well has hardened sufficiently to keep the spindle from turning, and the plug is then allowed to take its normal position in the socket, thereby again throwing the iron in circuit.

These irons have been in practical service in many laundries for several months and it is stated that without exception the users have furnished reports which indicate that the mechanism is sure to work in every instance and is in no way affected by constant heating. The company claims that there is no deterioration shown in the irons that have been equipped with this automatic cut-out mechanism and that this device will absolutely protect the iron against the usual burnouts.

Making the Smoke Record Its Own Misdoings

Careless firing is of course chiefly responsible for objectionable smoke from steam-boiler plants, but in combating this nuisance trouble has been experienced from the fact that the fireman does not know, from actual observation, whether his chimney is smoking. He has no time to go out and look at the stack frequently, and unless some other person notifies him he may permit the chimney to smoke for some time, entailing a fine from the smoke inspector, perhaps, and at any rate indicating uneconomical firing.

To bring to an end this state of affairs, Messrs. W. R. Bonham and William L. Weber, of Chicago, have invented an automatic smoke indicator and recorder which is novel and of some interest. In the breeching, just before it enters the stack, is introduced a perforated ring of piping or other means of taking out a small amount of the gases and other products of combustion which shall be a fair sample of the contents of the breeching throughout all its area. This ring is connected to a small pipe, to which is attached a small blower. The pipe is led around to the boiler front and terminates in a miniature smokestack on the firing floor, literally at the fireman's elbow. The draft in the pipe is carefully regulated in comparison with that of the stack, so that the smoke, if any, escaping from the little pipe in the boiler room is exactly the same, proportionally, as that discharged into the atmosphere perhaps 200 ft. above.

Obviously, the fireman has but to glance at his own little stack to see what is "doing" in the smoke line at the top of the big chimney for which he is responsible. He will perceive the smoke issuing from his pipe about a minute or a minute and a half before it reaches the top of the outside stack and can at once adjust his dampers or otherwise stop the smoke.

Further, the pipe from the breeching can be conducted to the office of the manager or chief engineer, on its way to the fireman's floor, and in these offices a glass bowl can be connected in the pipe, so that the man in charge can see at any moment whether smoke is passing into the chimney by simply looking at the glass tell-tale, without leaving his desk.

A valuable feature of the invention is the making by its aid an actual record of the smoke escaping from the stack for each 24 hours, by night, when it would be invisible, as well as by day. A jet is taken off from the little pipe in the boiler room, and this impinges on a tape or appropriately marked sheet revolved by clockwork. This record may be chemically prepared or merely covered with some sticky substance to hold mechanically the particles of carbon forced upon it by the jet from the miniature smokestack. By this means there will be an actual, visual record of the smoke issuing from the chimney for 24 hours, a black line on the tape showing the time and also indicating, by its heaviness or faintness, the amount of smoke escaping.

Chicago is said to have 17,000 steam-boiler plants, and as nearly all of them burn soft coal, its smoke problem is a serious one. Recently Mr. Bird, the chief smoke inspector for the city, addressed the Electric Club on the subject. He said that a smoke indicator or gage would be a great boon. Comparatively few inspectors would then be needed, for all that would be necessary would be to visit the plant occasionally, see that the apparatus was working properly and inspect the records. Mr. Bonham, who was present, explained the principle of the new device. Mr. Bird had never heard of it, but he was pleased with the plan, although somewhat surprised with the unexpectedly prompt response to his appeal for an invention.

All the details for the apparatus have not been worked out, but application has been made for a patent, and, simple as the idea is, there seems to be no anticipation, and it is believed that a broad patent will be issued.

It is thought that the use of a smoke indicator and recorder will appeal to the plant owner as well as to the city authorities. The device will enable him to judge the work of his firemen and to protect himself against wrongful accusation of producing smoke. Moreover, the plant that does not smoke is the economical plant.

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Commercial Intelligence.

THE WEEK IN TRADE.

General business conditions during the past week appeared to be considerably better than at any time since the beginning of the year. The prevalence of cold weather, together with the extensive post-holiday reduction sales, has done much to move a considerable amount of retail stock. The effect of this is felt among the wholesalers and jobbers by rather liberal re-orders. Spring orders have also been coming in with greater freedom and, while there is a tendency to conservatism on the part of the buyers, there is no doubt that a great deal more business is being actually done than has been transacted at any time within the past two months. The agitation of the tariff is doing something to restrict trade in many lines, and in some instances orders are being placed with provisional attachments that prices shall be regulated according to the tariff after the new bill is agreed upon. This class of business is not popular with jobbers because it leaves them uncertain as to the actual volume of their trade. It is only sanctioned where buyers of considerable quantities insist upon it. While the present severe weather, which has prevailed all over the West, has stimulated trade, it has also retarded shipments to a considerable extent and has blocked business in many rural sections. This may have some effect upon railroad earnings for the immediate weeks that it has prevailed, but as a rule the reports that are now coming in from the roads are the most favorable since the period of depression began in October, 1907. Reports for the latter part of December and for the first week of January show substantial gains, not only over the similar weeks of the year previous, but also over the average of the fall of 1908. Collections are very satisfactory all over the country, except in the heavy cotton growing portions of the South. In these localities the fact that the planters have not yet parted with their 1908 crops, owing to dissatisfaction over the prevailing price, has done much to limit the ability of the country merchants to meet their obligations. In the iron and steel trade all lines continue to be very dull. The tariff agitation seems to have a more serious effect upon this branch of industry than upon any other. Very few sales of pig iron are being made, and orders for finished material are coming in very slowly. The railroads, which are usually the heaviest buyers in January, are laggards this year. Rail orders which were anticipated for the early part of 1909 have not materialized. During the past week the New York Central sent out inquiries for 80,000 tons of steel rails and the Hill lines announced that specifications were ready for about 30,000 tons. So far as reported, neither of these orders has been placed as yet. It appears to be the policy of our conservative railroad managers to await full assurance of returning business before incurring additional liability. Reports from the building industry for 1908 as gathered by *Bradstreet's* for 83 of the principal cities of the United States, show a decrease of 10 per cent from 1907 and of 17 per cent from 1906. The monthly and quartely returns show that while the year began badly, there was a steady growth of building in the fall. The amount of building done in December, 1908, was considerably greater than in December, 1907, indicating that conditions in this line are gettting back to normal. Business failures for the week ended Jan. 14, as reported by *Bradstreet's*, were 319, against 329 the previous week, 431 in the like week of 1908, 234 in 1907, 279 in 1906 and 304 in 1905.

THE COPPER MARKET.

The copper market during the past week has been inactive and prices have shown an inclination to recede. In fact, quotations at the end of the week averaged about ¼ of a cent less than at the beginning of it. This is due to the fact that the heavy holdings of the European speculators have been to some extent liquidated. It is estimated that there is carried, on the speculative account in Europe, between 80,000,000 and 100,000,000 lb. With the tightening of the money market in financial centers abroad the burden of carrying this vast amount of metal becomes onerous. Added to this condition is the growing belief that the figures heretofore published concerning the stocks on hand in this country are practically correct. At the beginning of the year the best statisticians calculated that there was on hand, in this country, about 213,000,000 lb. These figures were vigorously denied by both the producers and the selling agencies, but as the returns from the smelters continued to come in, it seemed evident that they were not very far wrong. From government reports and from other data it is apparent that there came into the market in America, during 1908, from mine production and imports, something like 1,130,000,000 lb. The exports were 650,000,000 lb. The consumption was certainly less than 400,000,000 lb.—the government figures are 372,000,000 lb. This added to the known stock at the beginning of the year which the government statistics say was 126,000,000 lb. put the present surplus at something like the figures first named. While it is a recognized fact that the copper market is controlled by strong interests for the benefit of the copper stock market, speculators are timid about taking hold. The very uncertainty which has heretofore surrounded all copper statistics has been an advantage to the speculative element. With definite information as to production, such as it is now planned to furnish, the speculator will have little chance to do more than follow the natural trend of the market. At the meeting of the Association of Copper Producers, which was held last week, it was decided that Mr. L. C. Graton, of the United States Geological Survey, should be given charge of the collection and tabulation of copper statistics. Mr. Graton will not resign his position with the government unless the Department considers that his new work is inconsistent with public duties. If that is the case, he will resign and take up the statistical work for the copper producers. It will certainly be a satisfaction to have weekly and monthly statistics of production that are known to be fairly accurate. During the past week there has been little copper bought by the consumers. There is not a great deal of work being done by the electrical companies, and all of the larger concerns are fairly well stocked with metal. Speaking of the future, Mr. John Stanton, who is recognized as an authority among Lake Superior producers, declared that while he considered the present market unusually flat he was still anticipating large orders from equipment companies and for the electrification of railroads. Admitting that these orders were somewhat problematical, he still said that the copper producers were not despondent, but expected an early reawakening of the trade. Exports for the month of January, including Jan. 18, have been 12,600 tons. Quotations on the Metal Exchange on the date mentioned were:

Lake	14¼ @ 14⅜
Electrolytic	13⅞ @ 14
Castings	13¾ @ 13⅞

The London market was as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	60 7 6	60 5 0
Standard copper, futures	61 7 6	61 3 9
Market	Weak.	Weak.
Sales of spot		1,200 tons
Sales of futures		1,900 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	....	....
Lake	14.55	14.45
Electrolytic	14.25	14.05
Casting	14.12½	13.95
London, spot	£64 2 6	£60 5 0
London, futures	64 17 6	61 3 9
London, best selected	67 15 0	65 0 0

HOTEL FIXTURES.—An American Consul in the Far East reports that a company in that region will shortly be ordering furniture and equipment for two hotels which it expects to finish in a few months, and he suggests that the company be furnished with catalogs and net price lists of hotel equipment and furniture, especially in bath-room and sanitary equipment, heating plants, electric-light fixtures, etc. The company also proposes to furnish quite elaborately the president's office and a room for meetings of the board of directors. Address to which catalogs and correspondence should be sent can be obtained from the Bureau of Manufactures, Washington, D. C.

FAN AND BLOWER CONSOLIDATION.—The American Blower Company, of Detroit, Mich., announces its consolidation with the Sirocco Engineering Company, of New York, through negotiations carried out by President James Inglis of the former concern. Mr. S. C. Davidson of the parent "Sirocco" fan works, Belfast, Ireland, is financially interested in the deal. The factory of the Sirocco Engineering Company at Troy, N. Y., and the plants of the American Blower Company, Detroit, will continue in full operation under one management, and the home office will be at Detroit. In anticipation of a general improvement in business, also the necessity for increased foundry facilities, and the consummation of the "ABC"-"Sirocco" consolidation, the American Blower Company purchased outright during 1908 the complete foundry and plant formerly operated by the Northwestern Foundry & Supply Company, Detroit. The large triangular-shaped property owned and occupied by the American Blower Company since about 1881, being entirely covered by buildings by the completion in '07 and '08 of a large steel plate fan shop and office addition, the company purchased recently a large tract of land across the street, upon which it is expected new buildings, covering approximately 175 x 300 ft. will be erected. All business will hereafter be transacted under the style and name of American Blower Company at Detroit. Mr. James Inglis, the president of the new company, has been at the head of the American Blower Company; Mr. William C. Redfield, the vice-president, was president of the Sirocco Engineering Company; Mr. Charles H. Gifford, the treasurer, was until about a year ago general manager of the B. F. Sturtevant Company, and has had perhaps the longest experience of any official at present engaged in this line; Mr. Still, the secretary, is well known among engineers as chief engineer of the American Blower Company.

PRODUCER-GAS POWER EXTENSIONS.—The Compania Azucarera del Panuco, Tampico, Mexico, has placed an order with the Westinghouse Machine Company for a complete producer gas-electric power plant. This initial installation will consist of a vertical three-cylinder, single-acting engine and a 150-hp suction producer, to operate on small anthracite coal. Even larger sizes of producers of the suction type are contemplated by the builders. The New York Standard Watch Company, of Jersey City, N. J., also operates a suction producer plant of considerable size, and recently added another unit. A number of contracts have been let for gas engines operating temporarily on natural or illuminating gas, with the intention of later changing over to producer-gas operation. A 200-hp plant has been ordered by Seaver & Company, Chelsea, Mass., and by the Cambridge Gas Company, Cambridge, Md. The Shelbourne Falls (Mass.) Electric Light Company has adopted the power-gas system and has ordered a 175-hp Westinghouse suction producer for anthracite coal.

MOTION PICTURE COMBINE FORMED.—Plans for the combination of the two competing concerns manufacturing films for motion pictures have been completed and the consolidation, called the Motion Picture Patents Company, will begin business with a capital stock of $15,000,000. The two competing companies which have been invited were the Edison Company, called the "association," and the Biograph Company, which had been known as the "independent." Litigation over minor inventions has been going on between these two companies for years without any definite result. The new company takes over all the patent rights controlled by the Edison, Biograph, Jenkins, Pross, Vitagraph and Campbell companies. All the pictures of the new company, it is said, will be controlled by the Film Service Association. Under the proposed plans it is said that films will no longer be sold outright to show managers, but only rented. It is expected that the new arrangement will affect at least 50 per cent of the moving-picture shows in New York City.

WESTINGHOUSE ENGINE ORDERS.—The steam engine business of the Westinghouse Machine Company has been fairly active. Some of the contracts recorded in the last few months are as follows: Byron Jackson Iron Works, San Francisco, Cal., three compound engines for centrifugal pump drive; Kentucky State Hospital, Frankfort, Ky., three compound engines for central light, heat and power plant; Central Islip Hospital, Central Islip, L. I., two engines, and the Johns Hopkins Hospital, Baltimore, Md., three engines, both for isolated plants; Chicago, Minneapolis & St. Paul Railroad, one engine for railroad shop plant; T. A. Gillespie Company, contractors, one engine for construction work; Black Hills Traction Company, Deadwood, S. D., one engine for railway power plant.

UNITED FRUIT COMPANY INSTALLING WIRELESS.—Mr. M. Musgrave, chief of the wireless department of the United Fruit Company, announces that within the next six months practically every ship running out of New York, Boston, New Orleans and Mobile will be equipped with both wireless telegraph and telephone apparatus. Mr. Musgrave says that the big high-power wireless station at San Antonio, Cuba, will be ready for operation the latter part of February. It is guaranteed to have a radius of 600 miles in any kind of weather and of 1000 miles in favorable conditions. This is the most extensive of the United Fruit Company's stations. The others, located at Swan Island, Bluefields, Rama, Port Limon, Bocas del Toro and New Orleans, have maximum radii of about 250 miles.

FOREIGN TRADE.—The total merchandise imports for the year 1908 reached the sum of $1,116,402,243, and the exports $1,753,307,931, leaving an excess of exports of not less than $636,905,688, which is by far the largest in the history of the country, exceeding 1907 by more than $136,000,000. At the same time the contraction of international trade is shown by the fact that the total of imports and exports was $2,809,710,174 in 1908, whereas in 1907 it was $3,346,596,025. The excess of exports in December was $76,857,586.

UTILIZING SPARE POWER.—Mr. R. D. Kehrer, general manager of the Eagles Mere Light Company, Eagles Mere, Pa., writes us that the corporation has a water power plant of 490 ft. head, and has about 200 kw to dispose of, which it could furnish continuously. The water supply is practically constant, as there is a large lake for storage. The company is looking around for a consumer of its surplus and is investigating electrochemical industries as to nature of business, supply of raw materials, etc.

ELECTRIC SIGNS.—The U. S. Consular Reports note as follows: "A special inquiry has been received at the office of an American Consul from a British firm, requesting the names of American houses making a specialty of electric signs, either for inside or outside use. The electric work must be suitable for high voltage, and if satisfactory arrangements can be made the firm is of the opinion that good business will result."

CATALOGS WANTED.—The technical department of Bryant & Stratton College, Buffalo, is establishing a library and reading room for its students and requests to be placed on the mailing list of electrical manufacturing companies and supply dealers. All catalogs, etc., received will be kept on file for reference.

NEW WOOD ARC LAMP.—The Fort Wayne Electric Works are developing a new type of arc lamp, the latest invention of John J. Wood, factory manager of the works, and the inventor of the well-known line of Wood dynamos, motors and lamps. The new lamp will use metallic oxide electrodes.

Financial Intelligence.

THE WEEK IN WALL STREET.

When you come to consider the stock market during the past week you must consider the money market. As far as prices are concerned the money market has not counted very much, but it is really the only thing which the people in Wall Street are now talking about. The present money market at home is very little changed and therefore there is no practical reason why stocks should be affected on this account; but the money market abroad is a serious proposition. It is already understood that the Russian loan will amount to $278,000,000. While this does not drain the resources of the various imperial banks in Europe it certainly makes money a little closer in that section. The Bank of England has already advanced its rate from 2½ to 3 per cent. The Bank of France and the Bank of Berlin are closely scrutinizing loans, which really amounts to a contraction. In spite of this money in this market has been easy and apparently plentiful. The only effect of the European disturbance has been to curtail future commitments, but it has had little to do with immediate obligations. The market for stocks during the past week has been uncertain, first up and then down, with no material changes in any issue. The general tendency has been toward lower levels, but some stocks have shown strength and some have been weak without any apparent explanation in the technical conditions of the market. The entire week indicates that the professionals are still in charge,

and while it may be that they have permitted temporary recessions, a permanent break is hardly probable. The reports from the railroad companies show that during the last three months of 1908 there was a material increase in the volume of business. Doubts concerning the ability of the Erie Railroad to push through its reorganization program had a bearish effect upon the market, but the fact that Erie stock at best was dealt in to a limited extent restricted this influence. There has been very little improvement in the business world and on that account the minor fluctuations in the stock market do not mean much except the desire to buy or to sell which is indulged in by the speculators. Commercial business has not as yet returned to normal conditions, by at least 40 per cent. The iron and steel business has been conspicuously dull, and while the stock of the United States Steel Corporation has shown little weakness it is not because there has been a great amount of new business booked. These stocks while they represent actual money invested, are, as a matter of fact, the most speculative stocks on the market. They can be handled, and they are handled, by the professionals. The market, it may be said, is in a condition of abeyance. It is waiting for the next thing to turn up. It may be that a great increase in business, cheap money and a great desire on the part of outsiders to invest would bring about a large boom. It might be, on the other hand, that the absolute retirement of outsiders and the withdrawal of the professional support which large financial interests in Wall Street have undoubtedly afforded would mean a market decline. Taken altogether the Wall Street proposition is a problem and the fellow who guesses it right may be rich and the fellow who guesses it wrong will be broke. Stocks on Jan. 18 were inactive and prices were inclined to sag. There was an unaccountable activity in New York Central, but at the close the price was lower than at the opening. The money market was not active and rates were very cheap. Call loans were quoted at 1½ @ 2 per cent and 90-day paper at 2¾ @ 3 per cent. The quotations in the table are those of the close Jan. 18.

NEW YORK.

	Jan. 11.	Jan. 18.	Shares sold.		Jan. 11.	Jan. 18.	Shares sold.
All.-Ch.	15	14⅞	1,400	Int.-Met., pfd.	43¼	45½	118,800
All.-Ch., pfd.	47¾	47¾	1,970	Mackay Cos.	75*	75	100
Amal. Cop.	81½	78	135,945	Mackay Cos., pfd.	69½	70*	100
Am. D. T.	35*	35*	——	Manhattan Elev.	150	151*	783
Am. Loc.	55⅝	56	8,115	Met. St. Ry.	34¼	24	600
Am. Loc., pfd.	111	111*	400	N.Y. & N.J. Tel.	113	113*	90
Am. Tel. & Cbl.	78*	75½	150	Steel, com.	51¾	52¼	251,627
Am. T. & T.	126⅝	126	8,470	Steel, pfd.	112⅞	113¾	12,000
B. R. T.	68⅜	70¾	141,145	W. U. T.	68¼*	68¾*	750
Gen. Elec.	155½	155½*	4,380	West'h., com.	84	81	6,670
Int.-Met., com.	15⅜	16⅛	38,760	West'h., pfd.	120*	115	——

PHILADELPHIA.

	Jan. 11.	Jan. 18.	Shares sold.		Jan. 11.	Jan. 18.	Shares sold.
Am. Rys.	45½	45	——	Phila. Elec.	11¾	11⅝	——
Elec. Co. of A.	11⅛*	11⅛*	——	Phila. R. T.	26	26	——
Elec. Stor. B'ty.	44	44	——	Phila. Traction.	91¼	91	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	52⅛	52¼	——

CHICAGO.

	Jan. 11.	Jan. 18.	Shares sold.		Jan. 11.	Jan. 18.	Shares sold.
Chi. City Ry.	180*	180*	——	Chi. Tel. Co.	128	127¾	——
Chi. Rys., Ser. 1.	116*	116*	——	Met. El., com.	17*	17*	——
Chi. Rys., Ser. 2.	45½*	45½*	——	Nat'nal Carbon.	84½	84	——
Com. Edison	108	108	——	Nat. Carb., pfd.	112*	110	——
Chi. Subway	27⅛	26⅞	——				

BOSTON.

	Jan. 11.	Jan. 18.	Shares sold.		Jan. 11.	Jan. 18.	Shares sold.
Am. Tel. & Tel.	126⅝	126¼	——	Mex. Tel.	2½*	2½*	——
Cum. Tel.	126*	125	——	Mex. Tel., pfd.	5½*	5½*	——
Edison El. Ill.	247¾	246	——	N. E. Tel.	131	130	——
Gen. Elec.	156	156*	——	W. Tel. & Tel.	8*	8*	——
Mass. Elec. Ry.	11⅜	12	——	W. T. & T., pfd.	81*	82	——
Mas. E. R., pfd.	59	59½	——				

*Last price quoted.
Shares sold are for week Jan. 11 to Jan. 16.

DIVIDENDS.

Big Bend Light & Power Company, Spokane, Wash., quarterly, 2 per cent.

Butte Electric & Power Company, Butte, Mont., quarterly, preferred, 1¼ per cent., payable Feb. 1.

Commonwealth Edison Company, Chicago, Ill., quarterly, common, 1½ per cent, payable Feb. 1.

East St. Louis & Suburban Railway, East St. Louis, Ill., quarterly, preferred, 1¼ per cent, payable Feb. 1.

Electric Company of America, Philadelphia, Pa., semi-annual, common, 3½ per cent, payable Feb. 3.

Electric Bond & Share Company, New York, N. Y., quarterly, preferred, 1¼ per cent, payable Feb. 1.

Grand Rapids (Mich.) Railway, quarterly, preferred, 1¼ per cent, payable Feb. 1.

Havana (Cuba) Electric Railway, quarterly, common, 1 per cent, payable Feb. 15.

Havana (Cuba) Electric Railway, quarterly, preferred, 1½ per cent, payable Feb. 15.

Jacksonville (Fla.) Electric Company, semi-annual, common, 3 per cent, payable Feb. 1.

Jacksonville (Fla.) Electric Company, semi-annual, preferred, 3 per cent, payable Feb. 1.

Manhattan Electrical Supply Company, New York, N. Y., semi-annual, common, 3 per cent, payable Feb. 2.

Manhattan Electrical Supply Company, New York, N. Y., semi-annual, preferred, 3 per cent, payable Feb. 2.

Mexican Telegraph Company, New York, N. Y., quarterly, common, 2½ per cent, payable Jan. 15.

Michigan State Telephone Company, Detroit, Mich., quarterly, common, 1½ per cent, payable March 1.

Michigan State Telephone Company, Detroit, Mich., quarterly, preferred, 1½ per cent, payable May 1.

Milwaukee Electric Railway & Light Company, Milwaukee, Wis., quarterly, preferred, 1½ per cent, payable Jan. 31.

Minneapolis (Minn.) General Electric Company, quarterly, common, 2 per cent, payable Feb. 1.

Minneapolis (Minn.) General Electric Company, quarterly, preferred, 3 per cent, payable Feb. 1.

Montana Independent Telephone Company, Helena, Mont., quarterly, common, 1 per cent, payable Feb. 1.

New Hampshire Electric Railways, Haverhill, Mass., semi-annual, preferred, 1 per cent, payable Jan. 30.

Philadelphia Company, Pittsburgh, Pa., quarterly, common, 1½ per cent, payable Feb. 1.

Railway & Light Securities Company, Boston, Mass., semi-annual, preferred, $3 per share, payable Feb. 1.

St. Regis Light & Power Compay. St. Regis Falls, N. Y., quarterly, 1 per cent, payable Jan. 15.

Shawinigan Water & Power Company, Montreal, Can., quarterly, common, 1 per cent, payable Jan. 20.

STANISLAUS ELECTRIC POWER COMPANY.—A dispatch dated San Francisco, Jan. 17, states that news was received from New York of the closing of a deal whereby the United Railways of San Francisco obtained control of the Stanislaus Electric Power Company for $5,000,000. Mr. Patrick Calhoun, president of the United Railways of San Francisco, confirmed this purchase over a month ago, a note to that effect appearing in this column in the issue of Dec. 19. The dispatch states that the United Railways will effect a saving of half a million yearly by the purchase in addition to controlling one of the largest power plants in the West. Messrs. Sanderson & Porter, of New York, are the engineers for the Stanislaus power project.

GREAT WESTERN POWER COMPANY.—The vast hydro-electric power plant of this company on the Feather River, in California, is near enough to completion to offer assurances of its ultimate success. The company, through its tunnel on the big bend of the Feather River, will ultimately, so it is claimed, develop 430,000 hp. The company has already built a power house and installed a plant capable of developing 40,000 kw, of which 10,000 is now being transmitted to Oakland, Cal., 165 miles distant. The financing of this company, which involved $10,000,000, has been satisfactorily accomplished and there is nothing now remaining except to complete the installation and find a market for the power. The market, it is said, has been found and all the power the company can furnish will be easily disposed of.

BIG BEND LIGHT & POWER COMPANY.—Mr. W. C. Stivyer, president of the Big Bend Light & Power Company, of Spokane, Wash., in his annual report to the stockholders says with regard to the extension of the work: "We are now completing plans for the development of our power site on the Spokane River, 12 miles below Little Falls, where we will first develop 15,000 hp and later increase to 20,000 hp. Work will be pushed rapidly in the spring."

NEW YORK & ONTARIO POWER COMPANY.—The Public Service Commission of the Second District of New York has authorized the New York & Ontario Power Company, Waddington, N. Y., to issue $600,000 stock and $1,850,000 of 30-year 5 per cent gold bonds. The company is developing an important water-power project on the St. Lawrence River at Waddington, St. Lawrence County.

UNITED WIRELESS TELEGRAPH COMPANY.—The United Wireless Telegraph Company, New York, N. Y., has made public the following balance sheet, dated Nov. 30, 1908:

ASSETS.

	1908.	1907.
Good will and patent rights	$5,005,100	$500,000
Treasury stock, preferred and common	5,310,410	6,659,110
Stocks and bonds, other wireless companies	14,128,610	12,459,263
Factory and equipment	25,997	23,405
Stations, boats and equipment	502,942	229,988
Furniture and fixtures	3,975	4,085
Cash accounts, receipts, inventories, etc.	294,183	241,612
Total	$25,272,219	$20,117,463

LIABILITIES.

Capital stock	$20,000,000	$20,000,000
Bills and accounts payable	15,556	117,463
Surplus	5,256,662	.....
Total	$25,272,219	$20,117,463

The items of patents and patent rights include patents and patent rights in wireless telegraphy, wireless telephony and the fog-phone. The item of stocks and bonds includes stock that gives the company control of the International Telegraph Construction Company and its factory, patents, etc. The item of factories and equipments includes the factories at Jersey City and Seattle.

ONTARIO POWER COMPANY.—E. M. Farnsworth & Company, Boston, Mass., offer for subscription at 97½ and interest a limited amount of first mortgage 5 per cent gold bonds of the Ontario Power Company, Niagara Falls, Ont., dated Feb. 2, 1903, and due Feb. 1, 1943. The interest on the bonds is payable February and August in New York and Toronto. The bonds are callable as a whole during the first 10 years at 110. They are secured by a first mortgage covering the entire property of the company. The bonds so far issued on the 66,000 hp now installed amount to $70.60 per horsepower, and a sinking fund of $1 per horsepower sold will be established, beginning July 1, 1909, to buy the bonds in the open market up to 110. The Ontario Power Company numbers among its customers the New York Central & Hudson River Railroad and the Province of Ontario. The net earnings of the company for 1909, based on contracts already closed, are estimated at $658,275, an amount more than twice the interest on the bonds outstanding.

MICHIGAN STATE TELEPHONE COMPANY.—The establishment of a 6 per cent annual dividend rate for the common stock of the Michigan State Telephone Company, Detroit, Mich., has attracted attention to the securities of that company. The Michigan State Telephone Company is the successor of the Michigan Telephone Company, which defaulted on the interest on its $5,000,000 of bonds in 1902 and whose property was sold in July of that year to the bondholders for $4,000,000. The company is now estimated to be earning from 13 per cent to 15 per cent on its outstanding common stock and shows an annual increase of more than 12 per cent in new stations, with property assets approximating $18,000,000. On Nov. 1, 1909, $1,250,000 of the company's 6 per cent bonds will mature, and it is reported that arrangements will be made to retire them by issuing $1,500,000 of the $2,500,000 stock still remaining in the treasury of the company.

KEYSTONE TELEPHONE COMPANY.—At the annual meeting of stockholders of the Keystone Telephone Company, Philadelphia, Pa., at Camden, on Jan. 12, a statement of earnings was presented, supplementing the report of the company for the fiscal year ended June 30, 1908. The report for the year ended June 30, 1908, showed gross earnings of $1,051,071, net earnings of $511,948 and a surplus of $98,836 after all charges. The supplementary statement presented on Jan. 12 was for the six months ended Dec. 31, 1908, and showed gross earnings of $528,237, net earnings of $266,459 and a surplus of $59,480 after all charges. Mr. Nathan Folwell, president of the company, explained that the earnings were all being used for extensions and improvements, and presented a statement showing that for the calendar year $183,963 had been spent in improving the plant and equipment, and that $30,000 of the 6 per cent collateral trust bonds had been retired.

MASSACHUSETTS LIGHTING COMPANIES.—Mr. Arthur E. Childs, president of the Massachusetts Lighting Companies, Boston, has sent out to the stockholders a statement showing the earnings of the companies during the past year. The returns for 1908 were satisfactory both for the gas and electric properties in spite of the general depression of business. The figures as furnished by Mr. Childs show a total income of $725,000, and a net income of $247,000. After paying fixed charges there was $165,000 left for dividends on the stocks. The trustees felt warranted in declaring an extra dividend of ¼ per cent which is payable with the regular quarterly dividend Jan. 15.

SAN FRANCISCO GAS & ELECTRIC COMPANY.—An injunction, to remain in force during the pendency of the suit brought by the San Francisco Gas & Electric Company against the city, has been granted by Judge Van Cleek, of the United States Circuit Court, at San Francisco, to restrain the city authorities from enforcing the 85-cent rate fixed by the ordinance passed last year. The order provides that all money in excess of the ordinance rate paid by consumers shall be placed in a depositary approved by the court, to draw interest and to be distributed to the consumers or the gas company, according to the finding of the court.

CHICAGO RAILWAYS COMPANY.—The Chicago Railways Company announces that, as successor through the Chicago Union Traction Company to the West Chicago Street Railroad and the North Chicago Street Railroad, it will redeem at 102 and interest on Feb. 1, 1909, the following equipment trust obligations issued by the West Chicago Street Railroad and the North Chicago Street Railroad: West Chicago Street Railroad—All of series C, Nos. 1 to 70; series B, Nos. 1 to 73, inclusive. North Chicago Street Railroad—All of series C, Nos. 1 to 38; series D, Nos. 1 to 40, both inclusive.

BARTLETTSVILLE (OKLA.) ELECTRIC LIGHT & POWER COMPANY.—This company at its last meeting voted to add to its equipment, as soon as possible, two twin tandem gas engines, direct-connected to 500-kw generators and to erect about five miles of new transmission lines covering the entire town. The total capacity of the plant will then be 1360 kw with two steam and two gas engines all in parallel. The financial report for the year 1908 shows gross earnings of more than $17,000 and net earnings of $9,362.

MANISTEE LIGHT & TRACTION COMPANY.—Mr. John P. Reynolds, Jr., has been appointed receiver of the Manistee Light & Traction Company, Manistee, Mich., by Judge Knappan, of the Federal Court, on application of the New England Trust Company, Boston, Mass., trustee of the first mortgage bonds. The company is alleged to have defaulted in the payment of taxes and interest and otherwise to have violated the provisions of the mortgage.

REPORT OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Light & Traction Company, New York, N. Y.:					
Year ended Dec. 31, 1908	$2,723,064	$45,000	$2,678,064	*$2,030,254	$647,810
Year ended Dec. 31, 1907	2,463,158	36,563	2,426,595	*1,923,912	502,683
American Railways, Philadelphia, Pa.:					
December, 1908	237,419	.....	.....	.....	.....
December, 1907	231,671	.....	.....	.....	.....
Chicago (Ill.) City Railway:					
Eleven months ended Dec. 31, 1908	7,817,978	5,472,585	2,345,393	1,463,089	882,303
Eleven months ended Dec. 31, 1907	7,562,694	5,293,886	2,268,808	1,116,386	1,152,422
Detroit (Mich.) Edison Company:					
Year ended Oct. 31, 1908	1,571,206	907,997	663,209	421,887	241,322
Year ended Dec. 31, 1907	1,454,483	831,213	623,270	362,667	260,603
Economy Light & Power Company, Joliet, Ill.:					
Year ended April 30, 1908	276,881	119,892	156,989	64,145	92,844
Year ended April 30, 1907	230,882	108,912	121,970	40,234	81,736
Northwestern Elevated Railroad, Chicago, Ill.:					
December, 1908	189,197	.....	.....	.....	.....
December, 1907	164,235	.....	.....	.....	.....
Sao Paulo Traction, Light & Power Company:					
November, 1908	194,993	.....	.....	.....	.....
November, 1907	182,794	.....	.....	.....	.....
United Railways, St. Louis, Mo.:					
December, 1908	910,288	555,430	354,858	233,866	120,992
December, 1907	870,002	557,907	312,095	231,494	80,601

*Dividends and reconstruction reserve fund.

GENERAL NEWS

Construction News.

EUFALA, ALA.—The committee authorized to investigate the question of constructing a municipal electric light plant has been instructed to secure the services of an engineer to prepare plans and specifications for the same. Mayor McDowell is a member of the committee.

LEEDS, ALA.—A movement is on foot in this town to secure electrical service from the electric plant of the Standard Portland Cement Company and also to make connections with the telephone nad water works systems of the company.

HOT SPRINGS, ARK.—Plans are being considered by the Hot Springs Water Company for the installation of a 1500-kw water turbine. H. E. Martin is vice-president and manager.

LITTLE ROCK, ARK.—The Western Construction Company, of Minneapolis, Minn., has been awarded the contract for the construction of the proposed electric interurban railway of the Missouri-Arkansas Interurban Railway Company. The railway will extend from Joplin, Mo., to Bentonville, Ark., thence to Gentry, Tontitown and Springdale. A branch line will be built to Huntsville, Montene or Saloam Springs.

STUTTGART, ARK.—The Stuttgart Water & Light Company is making improvements to its plant necessary to provide for a 24-hour service, which will require the installation of additional machinery.

YELLVILLE, ARK.—Plans are being considered for the construction of an electric railway between Yellville and Rush Creek, electricity for which will be furnished by waterpower from Buffalo River, conveyed through a tunnel from Horeshoe Bend.

BERKELEY, CAL.—The Bay Counties Power Company is making arrangements to construct a new auxiliary power station in North Berkeley, which will practically be a duplicate of the substation just completed at end of Rose Street in the Berkeley Hills. The new station will do away with all the high-tension wires in Berkeley. The cost of the plant is estimated at $100,000.

CORONA, CAL.—The Corona Gas & Electric Light Company contemplates extending its transmission lines to the pumping plants to supply 1000 hp.

LOS ANGELES, CAL.—H. F. Vollmer has petitioned the City Council for a franchise to construct an electric railway on Fifty-fourth Street from Hoover to Dalton.

MODESTO, CAL.—The La Grange Light & Power Company has been granted a franchise by the Board of Trustees, for which it recently applied, it being the only bidder. The amount paid for the franchise was $225.

MODESTO, CAL.—Application has been made by the South San Joaquin Improvement Company to the Board of City Trustees for a franchise to construct and operate an electric railway in this city. It is proposed to grant the franchise, bids for which will be received until Feb. 17.

OAKLAND, CAL.—Plans have been completed by the Great Western Power Company for the erection of an electric power plant in Oakland, at an expenditure of about $1,000,000. Contracts for machinery have been placed. The proposed plant is to be used as an auxiliary to the Big Bend power station. It will be located on Sessions Basin. Contracts for piling and other preliminary work have been awarded to Healy, Tibbitts & Company, of Oakland, Cal. The first installation will provide for an output of 15,000 kw, with an ultimate expansion of 40,000 hp. Oil will be used for fuel. It is expected to have the plant in operation in about seven months.

PLACERVILLE, CAL.—Notice of appropriation of 2000 cu. in. of water in the North Fork of Cosumnes River to be diverted at Nashville for power and other purposes has been filed by W. P. Hyatt.

SACRAMENTO, CAL.—The City Board of Trustees has granted the Western Power Company a franchise to furnish electricity in Sacramento, Cal.

ST. HELENA, CAL.—Henry Brown and associates have been granted a fifty-year franchise to erect and maintain transmission lines for the distribution of electricity for lamps, heat and motors in St. Helena, Cal.

BOULDER, COL.—The Eastern Colorado Power Company has awarded a contract to MacArthur Brothers, of New York, N. Y., for the construction of the Barker reservoir dam, near Boulder. The dam is located on Middle Boulder Creek, about 17 miles from Boulder. It is to be of cyclopean concrete masonry and will be about 625 ft. in length and 180 ft. above bed rock. Construction work will begin about Feb. 1.

DENVER, COL.—Plans have been completed by the Skagit River Power Company for the construction of a 100,000-hp plant. E. M. Riggs is president of the company.

FORT MORGAN, COL.—Plans are being considered to install a 100-kw turbo generator set and a 150-hp boiler in the municipal electric light plant. George Cox is superintendent.

MONTROSE, COL.—It is reported that arrangements are being made to construct an electric railway covering the entire Uncompagre Valley, as well as the valley of the North Fork of the Gunnison. The railway will extend south from Montrose to Ouray and north to Delta, continuing up the North Fork of the Gunnison to Paonia and Hotchkiss, a distance of about 90 mile.s The promoters are said to be also considering extending the railway into Norwood, Naturita and Paradox districts in the west end of the county. I. N. Pepper is the Montrose representative.

NORWALK, CONN.—The City Council has awarded the contract for street lighting to the Connecticut Company for a term of three years. The company is to furnish an all-night service for four months in the year, the remaining eight months until 3 a. m. It is also to furnish the extra service without additional cost to the city. Under the old contract the lamps burned until 3 a. m. the year around.

NORWICH, CONN.—Plans are being considered by the Board of Gas and Electric Commissioners for changes in the municipal electric light plant, which include discontinuing the use of the rotary converter and changing all 500-volt, direct-current motors for alternating-current motors. William F. Bogue is manager.

ROCKVILLE, CONN.—The Rockville Gas & Electric Company will apply to the Legislature for an amendment to its charter allowing it to include in its territory the towns of Willington and Mansfield, as it is planning to extend its service to these towns. The company also wants the right to take land necessary to extend its transmision lines to both places.

WILMINGTON, DEL.—Plans are being perfected by the Smyrna, Kent County & Delaware Bay Traction Company for the construction of its proposed electric suspension railway in the Delaware Peninsula. J. W. Endean is president and chief engineer.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 2 for furnishing at the various navy and naval stations the following supplies: Philadelphia, Pa.: Schedule 811—Electric motor, drill press, engine lathes, etc. Also until Feb. 9: Mare Island, Cal.: Schedule 797—Three electrically driven bench drills, a motor-driven lathe, screw-cutting lathe, alternating-current buffing lathe, motor-driven tool grinder, universal tool and cutter grinder, a No. 4 high-power universal milling machine, two motor-driven tool grinders, drill press, electric tool post grinder, etc. E. B. Rogers is paymaster general, U. S. N.

MIAMI, FLA.—The East Coast Hotel Company has decided to install tungsten lamps for stret lighting. The change will necessitate the rebuilding of the entire system. Orders for material have already been placed. W. D. Avery will have charge of the work.

QUINCY, FLA.—The installation of a new dynamo and engine in the municipal electric light plant this year is contemplated. B. A. Puckett is manager.

ATLANTA, GA.—The Southern Power Company has secured options on about 40,000 acres of land on the Wateree River, extending from Wateree Creek to Getty's Shoals, for future development.

JESUP, GA.—The City Council is considering the question of issuing $25,000 in bonds, the proceeds to be used to purchase the present electric light system or install a new plant, and also for the construction of a water works systems.

LA GRANGE, GA.—Plans are being made to extend the arc and incandescent lamp circuits of the municipal electric light plant to a new section of the town.

THOMASTON, GA.—Plans are being considered for extensive improvements and additions to the municipal electric light plant, including the installation of a 140-hp boiler, one 140-hp engine, one 100-kw and one 175-kw alternating-current generator. H. H. Wheless is superintendent.

BOISE, IDAHO.—Specifications have been completed for extensions to the system of the Boise Valley Railway Company, calling for an expenditure of $140,000. It is proposed to extend the railway from Nampa to the Deer Flat irrigation reservoir, a distance of five miles, and to complete what is known as the South Boise loop at Morris Hill Cemetery. It is also proposed to construct and equip a substation at Meridian and purchase several interurban cars.

BOISE, IDAHO.—Arrangements are being made by the Boise & Interurban Railway Company for improvements and extensions to its system, which will involve an expenditure of about $200,000, and include double tracking the Pierce Park line, at a cost of about $100,000, and improvements to the park, at a cost of $10,000. The company also contemplates increasing the output of the substation at Pierce Park and erecting heavier feed wires nearly to the Caldwell end of the line. W. E. Pierce is president.

SANDPOINT, IDAHO.—The City Council has granted a 50-year franchise to A. Filson, F. M. Molyneaux, J. F. McBride, J. M. Prater, J. B. Southmayd and H. C. Olney to construct and operate a street railway in Sandpoint.

SANDPOINT, IDAHO.—It is reported that negotiations are under way for the purchase by Chicago capitalists of the plant of the Pend d'Oreille Electric Company, the controlling interest in which is owned by Jerome L. Drumheller, of Spokane, Wash. It is said the new owners propose to dismantle the steam plant in Sandpoint and electricity for operating the system will be transmitted from the water-power plants of the company.

Plans are being made for an expenditure of about $2,500,000 in the development of power sites and to furnish electricity to the whole panhandle of Idaho as well as Sandpoint.

CARROLLTON, ILL.—We are informed that the Carrollton Heat, Light & Power Company is planning to change its system to 60 cycles and install a 150-kw, three-phase, revolving field generator if the change is made. F. M. Sinsabaugh is secretary and treasurer.

CHAMPAIGN, ILL.—The Illinois Traction System is planning to extend its system from Seneca to Morris, a distance of 12 miles, material for which will be purchased at once. The new railway will be operated by the company under the name of the Chicago, Ottawa & Peoria Railway. The company is also making arrangements to change 100 miles of its system from alternating to direct current and will build eight substations. It is also proposed to construct a three-mile belt line in Decatur.

CHICAGO, ILL.—The City Council has granted the Calumet & South Chicago Railway Company a franchise to construct an extension in South Chicago Avenue between Vincennes Avenue and South Park Avenue; also permitting the company to build a single-track railway on 115th Street from Michigan Avenue to Halsted Street.

CHICAGO, ILL.—The drainage board of the Sanitary District of Chicago has awarded contracts for machinery and apparatus to increase the output of the water power plant at Lockport as follows: To the Western Electric Compnay, of Chicago, Ill., for generator, for $25,748; for furnishing transformers, to J. Jackson, for $18,500.

GALESBURG, ILL.—Plans are being considered by the People's Traction Company for the construction of an electric interurban railway between Galesburg and Galva, a distance of 24 miles, work on which will soon commence. Charles S. Harris is secretary and treasurer.

LA SALLE, ILL.—Arrangements are being made by the Central Union Telephone Company for extensive improvements to its system in La Salle and Peru during the coming year. The work will involve an expenditure of about $40,000.

LINCOLN, ILL.—The Lincoln Railway & Light Company is considering the question of installing a steam heating plant, using exhaust steam. C. F. Richardson is superintendent.

MONMOUTH, ILL.—The Rock Island-Southern Railroad Company has presented a proposition to W. D. Brereton, president of the Commercial Club, offering to construct an electric railway from Monmouth to Alexis if the sum of $200,000 is raised jointly between Monmouth and Alexis, the $126,300 already pledged in Monmouth to apply on the fund.

PAXTON, ILL.—The Chicago, Kankakee & Champaign Railway Company has been granted a franchise by the City Council to construct and operate an electric railway on Railroad Avenue. The proposed railway will extend from Kankakee to Champaign, a distance of 75 miles.

BLUFFTON, IND.—The County Commissioners of Wells and Adams Counties have ordered elections to be held in four townships Feb. 9 to vote on the proposition to give subsidies amounting to $34,000, asked by the Bluffton, Berne & Celina Traction Company. Franchises have been granted to the company in Celina, Ohio, the eastern terminal, and at Berne. Surveys have been completed and the right of way secured for three-fourths of the distance.

DECATUR, IND.—The question of installing a new street lighting system in connection with the municipal electric light plant is under consideration. Magnetite arc lamps will probably be installed. M. J. Mylott is manager.

EVANSVILLE, IND.—The American Bell Telephone Company will build a new substation in this city, work to commence early in the spring. The company will expend about $50,000 in improvements to its system in this city during the coming year.

GREENCASTLE, IND.—The board of trustees of the De Pauw University has decided to construct a new electric light plant during the coming spring and summer, the cost of which is estimated between $4,000 and $5,000. It has not been decided whether to erect a new building or build an addition to the present heating plant. R. L. O'Hara is president of the board of trustees.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company is planning to increase the output of its plant. A 300-kw steam turbine, four additional boilers, two large brick stacks, with coal and ash-handling apparatus for the entire plant, will be installed.

TERRE HAUTE, IND.—Plans are being considered for the construction of the large electric plant near the Fauvre mine to supply electricity for lamps, heat and motors to points within a radius of 100 miles. The cost of the plant is estimated at $1,000,000. F. M. Fauvre, president of the Citizens' Lighting & Heating Company, of Indianpolis, Ind., and the Fauvre Coal Company, of Terre Haute, Ind., is interested in the project.

TERRE HAUTE, IND.—The Fauvre & White Company, with offices in Indianapolis, has secured the contract for street lighting in West Terre Haute, Ind., at $66 per lamp; also a franchise to furnish electricity for commercial lighting. The company is building an electric generating plant at the mouth of the Fauvre coal mine in Vigo County, from which point electricity will be transmitted to a number of cities in Indiana. The Terre Haute, Iindianapolis & Eastern Traction Company holds the present contract for public lighting, which expires June 1, 1909.

COUNCIL BLUFFS, IA.—It is reported that the Independent Transportation Company is planning to construct a street railway system in Council Bluffs. The company will soon apply to the City Council for a franchise for the same. A. T. Flickinger is vice-president.

MAQUOKETA, IA.—Arrangements are being made by the Davenport, Maquoketa & Dubuque Railway Company to commence work on the construction of its proposed interurban electric railway this spring. The railway will be 90 miles in length and will connect Davenport, Maquoketa, Dubuque and intervening cities. The power station will be located in Maquoketa. The company will furnish electricity for lamps and motors to towns along the route.

PRIMGHAR, IA.—The Sioux City & Spirit Lake Railway Company has been granted a franchise to construct and operate a street and interurban electric railway in this town. The franhcise also provides for furnishing electricity for lamps and motors in Primghar.

SIOUX CITY, IA.—The Sioux City Telephone Company is contemplating extensive improvements to its system in this city, which will require an expenditure of about $75,000. The work will include the installation of a new switchboard at Morningside and four branch automatic exchanges. Howard S. Baker is president and general manager.

ARKANSAS CITY, KAN.—Contracts have been awarded by the Land & Power Company, of this city, for the construction of a power plant to cost $40,000, as follows: For construction of power house, to the Freeborn Engineering & Construction Company, of Kansas City, and the Allis-Chalmers Company, of Milwaukee, Wis., for furnishing the machinery. It is to be a hydro-electric plant with steam auxiliary plant.

ELLIS, KAN.—The contract for the construction of the municipal electric light plant and water works sytem has been awarded to Henry Bowman, of Belleville, Kan. The cost of the plants is estimated at $40,000.

HIGHLAND, KAN.—The Home Telephone & Electric Company is planning to install additional storage battery in its plant and establish a 24-hour service. L. B. Bender is president and manager.

MANHATTAN, KAN.—The Manhattan Ice, Light & Power Company is installing a 350-kw direct-connected unit in its plant. B. F. Eyer is vice-president.

TOPEKA, KAN.—The State Charter Board has granted the Kansas City & Kansas Southwestern Railroad Company an amendment to its charter, increasing its capital stock from $10,000,000, to $12,000,000. The company proposes to construct an electric railway from Kansas City to Independence, Kan., and from Kansas City to Topeka, Kan.

TOPEKA, KAN.—The Kansas City, Olathe, Ottawa & Iola Railway Company has applied for a charter to construct an electric railway from Kansas City, Kan., to Iola, a distance of 115 miles. The company will be capitalized at $5,000,000. D. Bowerstock, of Lawrence, Kan.; Robert A. Barr, of Kansas City, Mo.; Hugh A. Holmes, of Kansas City, Kan., and others are interested in the enterprise.

LEXINGTON, KY.—The Lexington & Interurban Railways Company is building an extension to Nicholsville, a distance of 12 miles. John B. Crawford is manager.

MANCHESTER, KY.—The Manchester Traction Company is making arrangements for the construction of an electric railway to connect London or Barboursville, Ky., with Manchester, Ky. The railway will consist of 25 miles of single track. Louis des Cognets, of Lexington, Ky., is president, and Hugh R. Manning, secretary and treasurer.

RICHMOND, KY.—Bids will be received by the Board of Regents of the Eastern State Normal School, Richmond, Ky., at the office of Anderson & Frankel, Lexington, Ky., architects, until Feb. 17, for constructing a heating and lighting plant and manual training building and distributing system and heating appliances for University Hall, at Richmond, Ky. Plans and specifications may be seen at the offices of the above architects or at the office of the Normal School, at Richmond, Ky. All bids should be addressed to the Board of Regents, Eastern Kentucky State Normal School, care of Anderson & Frankel, architects, Lexington, Ky.

THIBODEAUX, LA.—George U. Porde, Hibernia Building, New Orleans, La., consulting engineer, has been engaged by the Board of Aldermen to prepare plans and specifications for the construction of an electric light plant and waterworks system.

WINNFIELD, LA.—The North Louisiana Telephone Company has been consolidated with the Southwestern Telephone Company, which operates a telephone line from Shreveport to Beaumont. The headquarters of the company will be in Winnfield.

CORINNA, MAINE.—The Board of Trade is negotiating with John R. Graham, president of the Bangor Railway & Electric Company, of Bangor, Maine, in relation to transmitting electrical power from Charleston or Corinth to Corinna. It is understood that Ireland Brothers, who now furnish electricity in this town, are ready to make arrangements with Mr. Graham should he decide to extend the transmission lines of the company to this place, as they are unable to meet the demands for electrical service.

LEWISTON, MAINE.—Plans are being considered to increase the output of the municipal electric light plant to furnish electricity to light the city hall, Carnegie Library, fire houses and other buildings. The work will include the installation of another generator, switchboard and the extension of wires. The cost is estimated at about $2,000.

OAKLAND, MD.—The Oakland, Swallow Falls & Uniontown Electric Railway Company has completed surveys for its proposed electric railway from Oakland, Md., to Uniontown, Pa., with a branch from Swallows Falls down the river, about two miles to its hydro-electric plant; also a

branch from Cranesville to Kingwood, W. Va. The railway will be about 50 miles in length. A hydro-electric plant will be erected about six miles north of Oakland. The plant will have an output of about 10,000 hp and will furnish electricity for lamps and motors as well as for operating the proposed railway. The company is capitalized at $150,000. A. G. Sturgess is president and H. P. Tasker, general manager.

AVON, MASS.—The Edison Electric Illuminating Company, of Boston, has applied to the Selectmen for a franchise to erect poles and wires on East Main and High Streets. The company proposes to furnish electricity for lamps and motors for the shoe shop and offers to place lamps on both East Main and High Streets free of charge until the annual meeting in March, when the town will take action in regard to street lighting.

FITCHBURG, MASS.—Negotiations are under way by which the controlling interests of the Fitchburg Gas & Electric Light Company will pass into the hands of the Tenney-Royce Companies, which control other gas and electric plants in Massachusetts, including the Springfield Gas Light Company. The syndicate was represented by Charles H. Tenney, of Hartford, Conn.; Albert B. Tenney, of Everett, Mass., and Frederick H. Royce, of Dedham, Mass.

GLOUCESTER, MASS.—The Gloucester Electric Company contemplates the installation of a 500-kw, alternating-current generator direct connected. E. L. Munger is manager.

HUBBARDSTON, MASS.—H. S. Harriman, of the Connecticut River Power & Transmission Company, has notified James E. WcWilliams, of the Hygienic Blanket Mills and the Chemical Fire Extinguisher Company, of Hubbardston, Mass., that if suitable franchises can be secured in Hubbardston and Barre and the manufacturers of the two towns can contract for 200 hp the company might arrange to extend its transmission lines to both towns.

LYNNFIELD CENTER, MASS.—The question of establishing an electric light system in Lynnfield Center is under consideration. It is proposed to secure electrical energy from the municipal electric light plant in Reading, Mass.

SPRINGFIELD, MASS.—Colonel Stanhope E. Blunt, commandant at the United States Armory, at Springfield, Mass., has asked an appropriation from Congress, the proceeds to be used for the construction of an electric railway for freight purposes.

SPRINGFIELD, MASS.—The United Electric Light Company has petitioned the State Legislature for a change in the act which requires that not less than three nor more than five miles of its wires be placed underground each year, so that the act will require but one mile each year. The company has placed its wires underground on most of the important streets and now has its wires underground in about 48 miles of streets and is three miles ahead of the city's requirement. The streets which still have wires above ground are where there will be little business coming to the company, and it means an investment of between $8,000 and $10,000 a mile, upon which no return will be made. As the main thoroughfares and many of the less important ones are free from overhead wires, the company feels that it should be given a little relief from an annual expenditure of between $25,000 and $50,000 for underground work, upon which it gets but a small return.

STERLING, MASS.—The question of lighting the town by electricity is under consideration. It is proposed to purchase electricity from the Massachusetts Power & Transmission Company's plant of the Connecticut River Power & Transmission Company at Vernon, Vt.

DETROIT, MICH.—It is reported that the Michigan Central Railway Company has decided to equip its terminals in Detroit to be operated by electricity and the main line as far west as Ypsilanti, Mich., a distance of 30 miles. It is proposed to abolish local trains and use electric cars for local business, having the steam trains stop only at large cities. Electricity for operating the system will be furnished by a hydro-electric plant to be constructed on the Huron River at Chelsea, Mich.

ALBERT LEA, MINN.—The Albert Lea Light & Power Company has decided to make extensions and improvements to its plant, for which plans and specifications have been prepared. The work will include the installation of a 200 or 300-kw unit, a 200-hp boiler, 100-kw motor generator, transformers, three miles of pole line and five miles of gas mains. Ludwig Kemper is treasurer and manager.

FERTILE, MINN.—The electric light plant of the Fertile Brick & Tile Company has been closed, the company declaring that the plant is an unprofitable investment after five years' operation. It is said that the Council will compel the company to resume the service or it will cancel the franchise and order the poles and wires removed from the streets.

GRACEVILLE, MINN.—Plans are being considered to form a local company to establish a telephone exchange in Graceville. M. S. Stevens is interested in the project.

KASOTA, MINN.—It is reported that plans are being considered to extend the transmission lines of the municipal electric light plant at St. Peter to Kasota to furnish electricity for lamps.

HOUSTON, MISS.—Plans are being considered to install a new 125-kw generator in the municipal electric light plant. J. C .Arnold is manager.

MOUNT OLIVE, MISS.—Messrs. Houston & Cunnigham, 705 Maison Blanche Building, New Orleans, La., have been engaged to prepare plans for the construction of an electric light plant at Mount Olive, to cost $7,000. Bids for construction of the plant will be called for in about 60 days.

CLINTON, MO.—The Western Missouri Interurban Railway Company has applied to the City Council for a franchise to construct an electric railway through Clinton. The proposed railway will extend from Odessa through Warrensburg and Greenfield to Clinton, a distance of 75 miles. George S. Halliday, of Clinton, is president.

EAST ST. LOUIS, MO.—The City Council has granted a franchise to the Citizens' Electric Light & Power Company to construct and operate an electric light plant in this city. The company will furnish electricity for lamps for the fire engine house, police station and city hall, free of charge. Dr. A. A. McBrien is one of the promoters.

MAYSVILLE, MO.—A franchise has been granted to W. T. Wingate to operate an electric light system in Maysville.

GREAT FALLS, MONT.—It is reported that the Mackay Wall Plaster Company contemplates the construction of a dam on Belt Creek, the water power to be utilized to generate electricity to operate its mines.

ARAPAHOE, NEB.—The City Council has called a special election for Feb. 9 to vote on the proposition to construct a municipal electric light plant and water works system, to cost $6,000 and $24,000, respectively. E. C. Wagner is City Clerk.

FORT ROBINSON, NEB.—The contract for constructing an electric light system at Fort Robinson has been awarded to Samuel A. Oliver, of Crawford, Neb., for $32,000. Captain F. T. Arnold is quartermaster.

McCOOK, NEB.—The McCook Electric Light Company is planning to entirely rebuild its plant. A. R. Scott is manager.

OAKLAND, NEB.—It is reported that M. A. Drager, of Emerson, and R. H. Burton Smith, of Sioux City, propose to remodel the city power plant.

BUFFALO, N. Y.—Bids will be received until Feb. 3 by the State Commission in Lunacy, Albany, N. Y., for furnishing engine, dynamo, switchboard and feed-water heater and making changes to exhaust mains at the Buffalo State Hospital, Buffalo, N. Y. Plans and specifications may be seen and blank form of proposal obtained at the Buffalo State Hospital, or at the office of Franklin B. Ware, state architect, Albany, N. Y. T. E. McGarr is secretary of commission.

CARTHAGE, N. Y.—The Carthage Electric Light & Power Company is planning to install an additional 400-kw generator in its plant and to erect a new transmission line from Carthage to the plant. S. M. Strickland is secretary and manager.

NEWPORT, N. Y.—The Newport Electric Light & Power Company is planning to extend its transmission lines to Poland this year. George T. Woodin is president and manager.

NEW YORK, N. Y.—The Public Service Commission, Second District, has dismissed the application of the New York, New Haven & Hartford Railroad Company and the Harlem & Port Chester Railroad Company for consent to change its motive power upon the Harlem & Port Chester Railroad from steam to electricity, upon the ground that the companies are authorized to make such a change without the consent or approval of the commission.

OXBOW, N. Y.—Arrangements are being made to establish an electric lighting system in Oxbow.

WADDINGTON, N. Y.—The New York & Ontario Power Company has been granted permission by the Public Service Commission to issue capital stock to the amount of $600,000 and $1,500,000 in bonds. The company is developing a water power on the St. Lawrence River at Waddington. The present plans call for a development of about 17,000 hp.

ASHEVILLE, N. C.—Plans are being considered by the Asheville Electric Company for improvements and extensions to its plant, including the construction of a new power station. The cost of the work is estimated at $130,000. Frank K. Wade is electrical engineer.

GREENSBORO, N. C.—We are informed that the Randolph Power Company, recently incorporated, contemplates the installation of a small steam plant at first. C. W. Petty is interested in the project.

BUCYRUS, OHIO.—The City Council has passed a resolution authorizing the Board of Public Service to advertise again for bids for lighting the city, the contract to take effect June 1, 1909.

CAMBRIDGE, OHIO.—Mayor W. N. Bradford in his annual message recommends the construction of a municipal electric light plant for Cambridge.

COLUMBUS BARRACKS, OHIO.—Bids will be received until Feb. 8 for furnishing and installing transformer, etc., and making underground electric service connections to new post hospital, new bakery, disinfecting plant and new hospital corps sergeants' quarters at this post. Information, blank form for proposals, etc., furnished on application. Captain H. J. Hirsch is constructing quartermaster.

NAVARRE, OHIO.—The Mayor has advised the Council to take necessary steps to secure rights from the State to construct a dam in the Tuscarawas River, where it is said that 200 hp could be developed.

WOOSTER, OHIO.—The capital stock of the Wayne County Telephone Company has been increased from $10,000 to $100,000.

YUKON, OKLA.—The Yukon Mill & Grain Company, of Yukon, Okla., will receive bids until Feb. 15 for the following machinery and equipment: One 18 x 42 girder type Corliss engine; two 175-hp water tube boilers; 175-lb. pressure, with separator, etc.; two simplex pumps, and a 350-hp heater. Copies of blueprints and specifications will be furnished for $5.

COQUILLE, ORE.—Seymour H. Bell has applied to the Council for a franchise to erect transmission lines for the distribution of electricity in Coquille, Ore. It is said that Mr. Bell will make application for a franchise in Myrtle Point.

THE DALLES, ORE.—The Interior Development Company has appropriated 500,000 cu. in. of water from the Des Chutes River and proposes to reclaim thousands of acres of semi-arid lands in Wasco County. It is proposed to construct a dam 60 ft. high, with canal having screens and intakes, flumes, pipe lines; also the erection of a power house and installation of hydro-electric machinery. Work will begin in the spring. A. Welch is president.

BRADFORD, PA.—B. J. Gaffney, of Bradford, Pa., contemplates developing the water power of Beaver River to be utilized to generate electricity.

HONESDALE, PA.—The Lackawaxen Valley Railway Company, which is successor to the Honesdale & Hawley Railway Company, has been granted a 75-year franchise by the City Council to construct and operate a street railway in Honesdale. The company proposes to build an electric railway from Seeleyville to Hawley, a distance of 11½ miles.

LANSDOWNE, PA.—The Sharon Hill & Upper Darby Street Railway Company, which is controlled by the Interstate Railways Company, has applied to the Borough Councils of Aldan and Lansdowne for a franchise for a right of way from Chester Pike and Clifton Avenue, Sharon Hill, through the boroughs of Sharon Hill, Collingdale, Aldan, Lansdowne and the township of Upper Darby to a terminus at Sixty-ninth Street, Philadelphia, Pa.

MEYERSDALE, PA.—The Pennsylvania & Maryland Street Railway Company has been granted a franchise by the Borough Council of Garrett, allowing the company to operate its railway on three streets in the borough. The company proposes to extend its system to Berlin. The company now has in operation a railway from Salisbury through Meyersdale to Garrett.

NEW BRIGHTON, PA.—The Valley Electric Company is considering plans for the installation of a 500-kw turbine unit in its plant. C. A. White is manager.

ST. MARYS, PA.—The St. Marys Electric Company contemplates changing its generating system from 133 to 60 cycles. Edward Heath is secretary.

WEST NEWTON, PA.—The Pittsburg, McKeesport & Westmoreland Street Railway Company has decided to construct a street railway from Herminie to West Newton, contract for the construction of which will be let in the near future. The company has also decided to take over the property of the railway extending between McKeesport to Irwin, which is now in the hands of a receiver.

FLORENCE, S. C.—The Southern Public Service Corporation, of which P. A. Willcox is receiver, is contemplating the general rebuilding of its plant. F. G. Godfroy, of Florence, is general superintendent for the receiver. H. N. Cassell is local manager.

MARION, S. C.—The Carolina Water, Light & Power Company, which is in the hands of P. A. Willcox as receiver, is planning for a general rebuilding of its plant. F. G. Godfroy, of Florence, S. C., is general superintendent for the receiver. W. L. Black is local manager.

ROCK HILL, S. C.—The Rock Hill Water, Light & Power Company contemplates the general rebuilding of its plant. P. A. Willcox, receiver, and F. G. Godfrey, of Florence, S. C., is general manager.

NEW HOLLAND, S. D.—Bids will be received by Peter Jongeward, secretary of the Farmers' Co-operative Telephone Company, of New Holland, until Feb. 6 for the construction of 15 miles of telephone line.

SCOTLAND, S. D.—The Dakota Gas & Electric Power Company has been granted a 25-year franchise to operate an electric light plant in Scotland.

WOLSEY, S. D.—J. Fletcher, owner of the local electric light plant, contemplates the installation of a larger engine and generator in his electric plant.

ATHENS, TENN.—The Long Manufacturing Company, owners of the Athens Light & Power Company, has been awarded a contract for lighting the streeets of the city with 81 incandescent lamps. The streets have been in darkness since the expiration of the last contract, over a year ago. T. J. Long is president of the company.

JEFFERSON CITY, TENN.—The Jefferson City Electric Company contemplates erecting about one mile of transmission line. I. M. Coier is manager.

MEMPHIS, TENN.—The special committee appointed to investigate the question of installing an electric light plant at the poor and insane and the county workhouse estimates the cost of such a plant at $6,500. No action has yet been taken by the county court.

BRUNNER (P. O. HOUSTON), TEX.—It is reported that the Brunner Water & Light Company will commence work at once on the construction of an electric light plant and water works system to supply both services in Brunner and Chaneyville. The cost of work is estimated at $25,000. L. N. Yarborough, J. W. Pruett and others are interested.

BROWNWOOD, TEX.—The West Texas Telephone Company is planning to build a new system in this town, at an expenditure of about $30,000.

ENNIS, TEX.—The Ennis Ice, Light & Power Company contemplates the installation of a 200-hp boiler and a 200-hp engine in its plant this year. A. D. Brown is manager.

GREENVILLE, TEX.—The Greenville Power & Manufacturing Company has increased its capital stock from $15,000 to $25,000.

HOUSTON, TEX.—The Houston Electric Company is planning to enlarge its power house and install additional equipment. David Daly is manager.

MART, TEX.—The City Council has granted a franchise to James Nichols for the construction of an electric light plant in Mart.

PLANO, TEX.—Arrangements are being made by the City Council to establish a municipal electric light plant. For further information address J. C. Skinner.

SAN MARCOS, TEX.—F. F. Beck, of Buffalo, N. Y., representing an Eastern syndicate, which proposes to construct an interurban railway from Austin to San Antonio, has applied to the City Council for a franchise to and through this city. The company proposes to construct a belt railway in the city if a satisfactory franchise is given; also to erect its power house in San Marcos if a suitable site is donated.

TAYLOR, TEX.—The capital stock of the Citizens' Light & Power Company has been increased from $10,000 to $20,000.

WAXAHACHIE, TEX.—Plans are being considered to install an electric light plant in connection with the water works system. Estimates of the cost are now being secured.

WICHITA FALLS, TEX.—Application has been made to the City Council for a franchise to construct and operate an electric street railway in Wichita Falls by Edgar Scurry, Henry Sayles and N. Henderson.

GOLD SPRINGS, UTAH.—C. A. Short and H. R. Elliott are interested in a project to furnish electrical energy for the mines of Gold Springs and neighboring camps.

SALT LAKE CITY, UTAH.—The Salt Lake & Los Angeles Railway Company is contemplating equipping its railroad to be operated by electricity at a cost estimated at $300,000.

SALT LAKE CITY, UTAH.—The Salt Lake & Ogden Railroad Company is planning to equip its railway to be operated by electricity between Salt Lake City and Ogden. It is said contracts will soon be placed. Simon Bamberger is president.

VERNAL, UTAH.—The Vernal Milling & Light Company is making preparations to double the output of its electric plant in the near future and to extend its transmission lines. S. R. Bennion is president.

BRATTLEBORO, VT.—Negotiations are said to be under way between the Connecticut River Power Company and the Twin State Gas & Electric Company whereby the latter company will eventually abandon its Brattleboro plant and take electrical energy from the plant of the Connecticut River Power Company at Vernon, Vt. If the deal is carried through, the Connecticut company will purchase the pole rights of the Twin State Gas & Electric Company and erect a new high-tension transmission line.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is planning to raise its dam at Chittendon, Vt., 10 ft., thus doubling the capacity of the reservoir. The company has secured contracts during the last year to furnish electricity for lamps and motors in the towns of Castleton, West Rutland and Wallingford and along its transmission line to Wallingford, and will require more power.

ABINGTON, VA.—Application has been made to the Town Council for a franchise to operate an electric light and power system in Abington by Mr. Palmer, who proposes to construct a plant on the river about six miles south of town.

BURKEVILLE, VA.—The J. L. Bradshaw Cooperage Company, of Burkeville, contemplates the installation of a motor and generator in its plant to furnish electricity for lamps in Burkeville. The company wants to secure an engineer to prepare plans for the plant.

FORT MONROE, VA.—Captain Ernest R. Tilton, quartermaster, U. S. A., writes that contracts for furnishing machinery for electric system, etc., at Fort Monroe, bids for which were opened Jan. 4, have been recommended to be awarded as follows: For boilers, to the Heine Safety Boiler Company; to M. W. Hill, for engines, and to the Crook-Reis Company for construction of underground conduit, and to the McKay Engineering Company, Baltimore, Md., for dynamos, for $7,925.

CHEHALIS, WASH.—The Spirit Lake Power & Mining Company is making arrangements to connect the St. Helens mining district with the outside world by telephone, which will require the erection of 21 miles of line.

CHEHALIS, WASH.—The City Council has granted the Chehalis Electric Light & Power Company a 25-year franchise. It is understood that plans are being considered whereby the control of the lighting and power privileges of both Chehalis and Centralia will be under one management.

GRANITE FALLS, WASH.—Plans are being considered by the Granite Falls Electric Company to change its system from single-phase, 133 cycles, to three-phase, 60 cycles. C. H. Cleaver is secretary and manager.

HUSUM, WASH.—H. A. Ingram is installing an electric light and power plant at Luzon, in Klickitat County. The plant will also furnish electricity to pump water to irrigate about 6500 acres of land.

MILAN, WASH.—It is said that the Little Spokane Power Company contemplates greatly increasing the output of its plant in the near future.

It is proposed to construct a dam acros the waterway to furnish power to generate electricity for this section of Spokane County.

MT. VERNON, WASH.—The Mount Vernon Electric Light Company contemplates the installation of a 150-kw, three-phase, 60-cycle, alternating-current generator in its plant. W. H. Franklin is manager.

NORTH YAKIMA, WASH.—The North Yakima & East Selah Irrigation Company contemplates installing a water pumping plant, with a rating of about 3,000 hp, to furnish power to pump water for irrigation purposes. T. A. Noble, of North Yakima, is chief engineer.

OTHELLO, WASH.—R. S. Chapman, electrical engineer, who had charge of the electrical equipment of the Bitter Root Tunnel for the Chicago, Milwaukee & St. Paul Railway, is investigating the possibilities for furnishing electricity for lamps and motors in Othello and Beverly.

PROSSER, WASH.—The Prosser Falls Land & Power Company contemplates installing an entire new generating plant at a cost of $50,000. John Chisholm is superintendent.

SPOKANE, WASH.—Plans are being considered by the Spokane & Inland Empire Railroad Company to extend its railway from Colfax to Pullman, a distance of about 12 miles.

SPOKANE, WASH.—The Big Bend Light & Power Company is preparing plans for the development of its power site on the Spokane River, 12 miles below Little Falls. It is proposed to develop 15,000 hp and later increase it to 20,000 hp. The company holds franchises in Reardon, Davenport, Harrington, Ritzville, Springdale and Lind, Wash., and Whitefish, Mont. It purchases electrical energy from the Washington Power Company for operating its system in the Big Bend towns and has a steam plant in Whitefish, Mont. W. C. Sivyer is president.

TACOMA, WASH.—The City Council has authorized the Commissioner of Public Works to advertise for bids for furnishing Station C with two compressors, one air receiver and two electric motors with complete fittings.

TOPPENISH, WASH.—The Council has granted a franchise to the Northwest Light & Water Company to erect transmission lines and conduits for the distribution of electricity for lamps and motors in Toppenish.

CEDAR GROVE, WIS.—It is reported that the Wisconsin Foundry & Steel Works has been awarded a contract to furnish electricity for lighting in Cedar Grove.

CHIPPEWA FALLS, WIS.—Plans are being considered by the Dells Paper & Pulp Company to construct a large dam at Jim Falls, near Chippewa Falls. The company proposes to utilize the power to operate a large paper and pulp mill. It has not yet been decided whether the mill will be located in this town or at Eau Claire. In case the plant is located in the last-named place the power will be transmitted by wire.

OSHKOSH, WIS.—The Northern Hydro-Electric Company has awarded the contract for the construction of a dam and power plant on the Peshtigo River, 14 miles below Crivitz, to the Bates-Rogers Construction Company, of Chicago, Ill. The company proposes to erect transmission lines to Green Bay, a distance of 50 miles, where, it is said, it has a contract with the electric light and power company of that city for the entire output of the plant.

WAUSAU, WIS.—The Wausau Telephone Company is planning to make extensive improvements to its system and has placed an order for 220,000 ft. of 50 and 100 pair lead cable. The telephone line from Wausau to Merrill on the west side of the river will be rebuilt; it is also planned to extend the telephone line from Brokaw to Granite Heights. The cost of the work is estimated at from $10,000 to $12,000.

MEETEETSE, WYO.—We are informed that Fred. C. Schaub, of Cody, Wyo., is planning to erect an electric light plant in Meeteetse, Wyo., in the near future, and also has a contract to pump the water for the water system of the town. The plant will be operated by water power from Greybull River.

SHERIDAN, WYO.—Plans are being made by the Sheridan Electric Light & Power Company for the installation of a 500-kw, 60-cycle, 2300-volt unit in its plant. Judson Bibb is manager.

EDMONTON, ALB., CAN.—The managers of the municipal electric light plant contemplate installing an additional 1000-kw generator and engine in the municipal electric light plant. A. W. Ormsby is superintendent.

McLEOD, ALB., CAN.—Bids are now being asked for two new boilers and a 260-kw direct-connected generator for the municipal electric light plant. G. H. Altham is superintendent.

WINNIPEG, MAN., CAN.—The City Council has decided to consider the proposition of allowing the Winnipeg Street Railway Company to sell its interests in this city. The company operates the street railway, light and power systems in Winnipeg, which are estimated to be worth from $15,000,000 to $20,000,000.

MONCTON, N. B., CAN.—The municipality of Moncton will make application to the incoming Legislature for power to construct and operate an electric street railway in the city of Moncton and the parishes of Moncton and Shediac, to lease such railway and to grant the right to construct and operate such railway to any other person or persons upon such terms as shall be approved by the City Council from time to time, and to generate, use, sell or supply electricity for such street railway. John S. McGee is city clerk.

FORT WILLIAM, ONT., CAN.—Plans are being considered by the Board of Water, Light and Telephone Commissioners for general extensions to the municipal electric light plant, for which $10,000 has been voted. Charles J. Moors is superintendent.

MORRISBURG, ONT., CAN.—The Morrisburg Electric Railway Company has applied to the Legislature for permission to extend its railway from Ormond to a point near Ottawa.

TORONTO, ONT., CAN.—The following towns are reported to have voted in favor of purchasing electricity from the Hydro-Electric Commission of Ontario: Amherstburg, Bothwell, Chatham, Comber, Dundas, Elmira, Essex, Glencoe, Leamington, Norwich, Port Stanley, Ridgetown, Simcoe, Sandwich, Stratford, Tilbury, Tilsonburg, West Lorne. Adam Beck is chairman of commission.

TWEED, ONT., CAN.—The Tweed Electric Light & Power Company contemplates increasing the output of its plant and will install a 100-kw, two or three-phase generator. J. T. Kissack is secretary and manager.

MONTREAL, QUE., CAN.—The Saraguay Electric & Water Company contemplates the erection of about 20 miles of transmission lines during this year. E. Champagne is manager.

MONTREAL, QUE., CAN.—The City Council has made temporary arrangements with the Montreal Light, Heat & Power Company to continue the stret lighting service under what the Council calls an open contract. No terms have yet been made for time or price for the service.

SASKATOON, SASK., CAN.—Bids will be received by J. H. Trusdale, City Clerk, until Feb. 3 for furnishing 500-hp boilers in two or threee units. Plans and specifications, also form of tender, may be seen at the office of the electrical superintendent. E. L. White is electrical engineer.

Company Elections.

SKOWHEGAN, MAINE.—At the annual meeting of the Skowhegan Electric Light Company the following named officers were elected: F. G. Danforth, president; A. H. Wyman, auditor, and M. B. Heselton, clerk; directors, Blin W. Page, A. H. Wyman, C. J. Abbey and C. P. Merrill.

FALL RIVER, MASS.—At the annual meeting of the Fall River Electric Light Company the following named directors were elected: Edward L. Anthony, George A. Ballard, Rufus W. Bassett, Jerome C. Borden, Albert F. Dow, Robert S. Goff, Oliver S. Hawes and James E. Osborn. The directors elected the following officers: Jerome C. Borden, president; Albert F. Dow, treasurer, and Owen Durfee, clerk.

DISPATCH, N. Y.—At the annual meeting of the Dispatch Heat, Light & Power Company the following directors were elected: Horace E. Andrews, John Carstensen, E. B. W. Rossiter, W. K. Vanderbilt, Jr., Daniel M. Beach, Walter N. Kernan and Albert W. Harris.

ROCHESTER, N. Y.—At the annual meeting of the Eastern Monroe Electric Light & Gas Company the following named directors were elected: Horace E. Andrews, W. K. Vanderbilt, Jr., E. B. W. Rossiter and Walter N. Kernan.

COLUMBUS, OHIO.—At the annual meeting of the stockholders of the Columbus Light, Heat & Power Company, a subsidiary of the Columbus Railway & Light Company, the following directors were elected: Butler Sheldon, Frank T. Stewart, George Hardy, Harford T. Stewart and William K. Lanman. The board was organized as follows: Butler Sheldon, president; Frank T. Stewart, vice-president; Herbert M. Burrington, secretary and auditor.

MECHANICSBURG, OHIO.—At the annual meeting of the Long Manufacturing Company, owners of the Mechanicsburg Light & Power Company, of Mechanicsburg, Ohio, and the Athens Light & Power Company, of Athens, Tenn., the old board of directors was re-elected.

PITTSBURGH, PA.—At the annual meeting of the Pittsburgh, McKeesport & Westmoreland Railway Company the followng named officers were elected: Manning Stiers, of New York, N. Y., president; J. J. Robertson, of West Newton, Pa., vice-president; R. W. Harvey, of Monongahela, Pa., secretary, and H. D. Lyon, of Pittsburgh, Pa., treasurer.

New Industrial Companies.

THE YOUNGSTOWN DRY CELL COMPANY, of Youngstown, Ohio, has been incorporated, with a capital stock of $5,000, by Irvine Strouther, C. A. Pettiford, F. B. Leece, G. L. Tarver and Robert Stewart.

THE ELECTRIC CHEMICAL PERMANENT BETTERMENT COMPANY, of Newark, N. J., has been incorporated, with a capital stock of $120,000, by George Stern, Charles Lefkourtz and Charles Henry Williams.

THE FISHER MANUFACTURING COMPANY, of South Bend, Ind., has been incorporated, with a capital of $25,000, to manufacture electrical machinery, electric supplies, batteries, coils, lamps ,etc. A. W., E. H. and F. W. Fisher are directors.

THE NEW JERSEY GAS & ELECTRIC FIXTURE COMPANY, of Passaic, N. J., has been chartered, with a capital stock of $10,000, by Jacob Wisner, Max Madow and William Madow. The company proposes to manufacture gas and electric fixtures.

NAYLOR & NEWTON, of Long Branch, N. J., has been chartered, with a capital stock of $25,000, by H. M. Browne, F. W. Mills and E. Forhan, of New York, N. Y. The company proposes to do an electrical contracting, construction and repair business.

THE PATTERSON SIGN ELECTRICAL COMPANY, of Buffalo, N. Y., has been chartered, with a capital stock of $10,000, to manufacture signs for display advertising. The incorporators are Frederick J. Sauer, Charles B. Graves and John Reitz, of Buffalo, N. Y.

THE STRAUSE BOILERINE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000, by Salo D. Straus, Sara Straus and Louis Straus, all of New York, N. Y. The company proposes to manufacture boiler compounds, engineers' specialties.

THE UNITED TUNGSTEN LAMP COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000, to manufacture lamps and appliances. The incorporators are Thomas F. Farrell, Joseph J. Schmidt and Harry G. Anderson, all of New York, N. Y.

THE ACME METAL MANUFACTURING COMPANY, of New York, N. Y., has been chartered, with a capital stock of $5,000, by H. Betts Hengerer, James H. Betts and Charles D. Winters, of New York, N. Y. The company proposes to manufacture electrical and other advertising signs.

THE SECRET PARTY LINE TELEPHONE COMPANY, of Brooklyn, N. Y., has been chartered, with a capital stock of $50,000, to manufacture a patented article to secure privacy in use of telephone. The incorporators are R. Hamilton, E. F. Linton and J. R. Clark, all of Brooklyn, N. Y.

THE CAR LIGHTING & POWER COMPANY, of Augusta, Maine, has been incorporated, with a capital stock of $8,000,000, for the purpose of dealing in machinery and apparatus for lighting, heating and propelling railway cars and locomotives. J. Berry, of Augusta, Maine, is president and treasurer.

THE ECONOMICAL GENERAL REPAIR & SUPPLY COMPANY, of New York, N. Y., has been chartered, with a capital stock of $2,000, by A. Adler, Adolph Mendel and Emanual Klein, all of New York, N. Y. The company proposes to do electrical work, deal in gas and electrical fixtures, plumbing, etc.

THE INDICATOR SALES COMPANY, of New York, N. Y., has been chartered, with a capital stock of $10,000, to manufacture pressure indicators and regulators, etc. The incorporators are: Robert Farles and John Luppert, of Williamsport, Pa.; L. W. Lissberger and Jacobs Wellington, both of New York, N. Y.

THE RELIABLE NOVELTY & ELECTRIC COMPANY, of Binghamton, N. Y., has been chartered, with a capital stock of $5,000, to manufacture electrical motors, machinery, etc. The incorporators are Frederick W. Newman, Gustavus Millard, Robert T. Hullar, Louis Z. Green and Frank D. Croft, all of Binghamton, N. Y.

THE SAN PEDRO ELECTRIC LIGHT & POWER COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $100,000. The incorporators are Willard Hein, Harry Hein and Enrique Naltes, all of New York, N. Y. The company proposes to carry on the business of contractors and engineers.

THE PLANET ENGINEERING COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000, by E. M. Sawtelle, of Englewood, N. J.; J. H. Wallace, L. E. Gunderson and M. Gintzler, of New York, N. Y. The company proposes to carry on a business of engineers, architects, chemists and industrial experts.

THE TELEPHONE OPERATING & CONSTRUCTION COMPANY, of Middletown, N. Y., has been incorporated, with a capital stock of $2,500, for the purpose of constructing and operating telephone and telegraph lines. The incorporators are: Edwin Fanchier, Sayer Fanchier and Edmund Millen, of Middletown, N. Y., and others.

THE MECCA MACHINERY COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $50,000, to manufacture and deal in machinery, mechanical devices, etc. The incorporators are John W. Danielson, Horace L. Roberts, John E. Dahlgren, Carl B. Larson and Charles B. McKeever, of Brooklyn, N. Y.

THE SCHENIC ELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $5,000, to carry on a business of electrical contracting. The incorporators are: Harvey V. Finch, of Jersey City, N. J.; Charles F. De Sona, of New York, N. Y., and Clinton Stark, of East Orange, N. J.

THE ELIZABETH AUXILIARY FIRE ALARM COMPANY, of Elizabeth, N. J., has filed articles of incorporation, with a capital stock of $30,000, for the purpose of constructing fire alarms and fire alarm systems and to carry on an electrical business. The incorporators are: Dennis F. Collins and Robert L. Patterson, of Elizabeth, N. J., and Oliver M. Schafer, of Trenton, N. J.

THE RICHARDSON ELECTRIC COMPANY, of Duluth, Minn., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing and dealing in electrical apparatus and appliances, and machinery of every kind; also to engage in all branches of electrical engineering and construction work in connection with light and power plants; and also to purchase, generate and distribute electricity for all purposes. The incorporators are William P. Bear, Frank Windblade, Axel W. Lindgren and Walter L. Seaton, all of Duluth, Minn.

New Incorporations.

PELL CITY, ALA.—The St. Clair County Telephone Company has been incorporated, with a capital stock of $10,000, by L. Cooke, J. F. Cooke, E. E. Cooke and W. P. Cooke.

AMITY, ARK.—The Cedar Point & Amity Telephone Company has been organized by J. F. Sheets, A. L. and T. A. Hawkins, S. R. Harrison and M. L. C. Small.

PASADENA, CAL.—The Pasadena Rapid Transit Company has been incorporated, with a capital stock of $3,000,000, to operate a third-rail electric railway, connecting Los Angeles and Pasadena. The incorporators are Horace M. Dobbins, George H. Hayes, W. H. Smith, Edward J. Sheehan and Don C. Porter. Ernest H. May, president of the Pasadena National Bank, has been elected treasurer of the company.

COVENTRY, COL.—The Naturita Telephone Company has been chartered, with a capital stock of $50,000, by G. A. Akers, H. H. Ross, Henry Pamm, George M. Hook and Arthur Priestly. The company proposes to construct telephone lines through Montrose and San Miguel Counties.

CHICAGO, ILL.—The Chicago, Joliet & Pacific Railway Company has been incorporated with a capital stock of $50,000 to construct an electric railway from Chicago to Keithsburg, Ill. The incorporators are: George Fuller, Isaac B. Fuller, William H. Richardson and Charles F. Blue, all of Chicago, Ill.

MOLINE, ILL.—Articles of incorporation have been filed for the Tri-City & Northeastern Interurban Street Railway Company by C. E. Peck, J. W. Simonson and G. W. Turner. The company proposes to operate a street railway from Watertown, Ill., to Albany, Ill.

RILEY, IND.—Articles of incorporation have been filed for the Farmers' Independent Telephone Company, with a capital stock of $1,000, by Harley Brill, William Clingerman, Everett Fox, Charles Adkins and others.

KEOKUK, IA.—The Keokuk Gas & Electric Company has been incorporated, with a capital stock of $300,000, by Frederick Sargent and others.

TOLEDO, IA.—The Commercial Telephone Company has been incorporated, with a capital stock of $5,000, by C. E. Fleming, president, and W. A. Dexter, secretary.

FRANKFORT, KY.—Articles of incorporation have been filed with the Secretary of State for the Midland Electric Company, of Fayette County, with a capital stock of $100,000 by Warren O. Griffith, Pendelton Beckley, Arthur Lipper, J. E. Cope Morton and Walter M. Griffith.

PAINTSVILLE, KY.—The Johnson County Telephone Company has been incorporated with a capital stock of $5,000 by B. K. Given, D. J. Wheeler and others.

BARRYTON, MICH.—Articles of incorporation have been filed for the Barryton Rural Telephone Company, with a capital stock of $10,000. The directors are Henry Walroth, D. Wait and Charles Gawner.

DEXTER, MICH.—Articles of incorporation have been filed for the Dexter Telephone Company, with a capital stock of $10,000.

FLINT, MICH.—Articles of incorporation have been filed for the Flint Electric Company with a capital stock of $10,000 by E. F. Loud, of Au Sable, Mich.; N. S. Potter, of Jackson, Mich., and H. Kimball Loud, of Au Sable, Mich. The company proposes to construct 13 dams in the Au Sable River, at a cost of about $8,000,000. It has been granted a franchise in Flint and expects to have its plant in operation by February, 1910, and will furnish electricity in several counties.

RIGA, MICH.—The Riga Telephone Company has filed articles of incorporation, with a capital stock of $3,000.

PIPESTONE, MINN.—The Moody County Telephone Company has been incorporated, with a capital stock of $36,000.

PLATTSBURG, MISS.—Articles of incorporation have been filed for the Plattsburg Telephone Company, with a capital stock of $10,000, by H. B. Watkins, H. M. Woodall and others.

TUTWILER, MISS.—The Tutwiler Water & Light Company has been chartered, with a capital stock of $10,000, by D. W. Harrison, A. J. Rylee, O. E. Bradford and others.

BUTLER, MO.—A certificate of incorporation has been issued to the Butler, Peru & Pleasant Gap Telephone Company. The company is capitalized at $5,000, and the incorporators are J. I. Bartlett, N. Blough, C. M. Thomas, U. S. Isom and R. R. Eason.

COLUMBIA, MO.—A charter has been granted to the Mexico & Jefferson City Electric Railway Company, with a capital stock of $600,000, to construct an electric railway from Mexico to Jefferson City, via Ashland and Columbia, 60 miles in length. The incorporators are: T. F. Whiteside, C. F. Spaerta, Turner S. Gordon, A. J. Estes, John Williams, E. F. McCallister and C. A. Marshall, of Columbia, Mo., and W. C. Carroll, of New York, N. Y.

BUTTE, MONT.—The Independent Messenger & Telephone Company has been incorporated. The company is capitalized at $10,000, and the incorporators are F. W. Graff and others.

ANSLEY, NEB.—The Box Elder Telephone Company has been incorporated, with a capital stock of $25,000, by E. B. Wait, H. Springman and others.

PAVILION, N. Y.—The Pavilion Telephone Company has been incorporated with a capital stock of $10,000 by B. J. Bernd, G. D. Hudson and others.

TUSCARORA, N. Y.—Articles of incorporation have been filed for the Tuscarora Telephone Company with a capital stock of $5,000 by J. W. Slaight, T. J. Carbrey and J. H. Rowan.

GOLDSBORO, N. C.—The Goldsboro Traction Company has been granted a charter to construct and maintain a street railway. The incorporators are E. T. Oliver and J. H. Trent, of Raleigh, N. C.; S. L. Blackburn, of Richmond, Va., and J. S. Oliver, of Goldsboro, N. C. The company is capitalized at $150,000.

NORTHWOOD, N. D.—The Avon Pleasant View Telephone Company has been incorporated, with a capital stock of $25,000, by T. O. Mandt, E. Corkins, John Pletron and others, all of Northwood, N. D.

HOPEDALE, OHIO.—The Hopedale Telephone Company has been chartered, with a capital stock of $5,000, by W. V. Scott, J. K. Skeely, J. B. Beadle and others.

TULSA, OKLA.—The Citizens' Telephone Company has been organized by J. I. Gillespie, C. W. Avery, J. W. Sloan and others to establish a telephone system in Tulsa.

PORTLAND, ORE.—Articles of incorporation have been filed for the Citizens' Independent Telephone Company by Everett D. Adamson, Roscoe R. Giltner and William D. Quinn. The company is capitalized at $6,000.

BLUE RIDGE SUMMIT, PA.—The Blue Ridge Mountain Telephone Company has been incorporated, with a capital stock of $5,000, to erect a telephone line from Blue Ridge to Liberty.

PITTSBURGH, PA.—The Woodlawn Light & Power Company has been chartered with a capital stock of $5,000. The directors are: J. B. Laughlin, treasurer; B. F. Jones, William Larimer Jones, Willis L. King, W. C. Moreland, all of Pittsburgh, Pa.

SLATEDALE, PA.—The Slatedale Electric Light, Heat & Power Company has been chartered with a capital stock of $10,000. Wilson Rex is president and Henry W. Bloss, secretary and treasurer.

DALLAS, S. D.—Articles of incorporation have been filed for the Tripp-Myer Telephone Company, with a capital stock of $10,000.

JONESBORO, TENN.—The Weaver Electric Company has been incorporated with a capital stock of $1,500 by Marvin Weaver, Hugh A. Bowers, Charles A. Weaver and others.

Legal.

MANISTEE LIGHT & TRACTION COMPANY IN RECEIVER'S HANDS.—The United States Court of Grand Rapids, Mich., has appointed John P. Reynolds receiver of the Manistee Light & Traction Company, of Manistee, Mich., on petition of the New England Trust Company, of Boston, Mass. The company operates electric lighting, gas and street railway systems in Manistee, Mich., and has defaulted interest on $1,500,000 in bonds outstanding.

Obituary.

MR. W. E. LOCKWOOD.—We regret to note the death on Dec. 28, at Auburn, Cal., of Mr. William Elisha Rockwood, the president and founder of the Rockwood Manufacturing Company, of Indianapolis, Ind.

MR. A. I. BRECKENRIDGE, purchasing agent and general storekeeper of the Waterloo, Cedar Falls & Northern Railway, Waterloo, Iowa, is dead. Mr. Breckenridge was born in Meriden, Conn., Aug. 12, 1845, and was graduated from Trinity College, Hartford, in 1870.

MR. G. C. T. ABOILARD.—We regret to be advised of the death of Mr. G. C. T. Aboilard, head of the firm of Aboilard & Company, Avenue de Breteuil, Paris, France, where he died suddenly Dec. 30, 1908, at the age of 58, his home being situated within the yard of the great factory with which he was so long connected. The firm was virtually a branch of the Western Electric Company, and a large amount of insulated wire and cable was made by it annually for French and other telephonic purposes. Mr. Aboilard, who was thus an intimate associate of Mr. F. R. Welles, vice-president of the Western Electric Company, resident in Paris, was prominent in industrial circles in that city and was well known to many American visitors. Some years ago he received the decoration of an officer of the Legion of Honor. The funeral exercises occurred on Jan. 2 and the remains were interred in the cemetery of Pere Lachaise.

Personal.

MR. A. R. BREWER, for many years secretary of the Western Union Telegraph Company, has been elected treasurer of the same company.

MR. J. C. WILLEVER, executive clerk for the Western Union Telegraph Company, has been elected to fill the position of secretary of the same company.

MR. FRED. C. SCHRAUB will in the near future install a hydro-electric plant in Meeteetse, Wyom., utilizing a water power on the Greybull River.

MR. FRANK A. POOR has resigned as sales manager of the Bay State Lamp Company to become general sales manager of the Hygrade Incandescent Lamp Company.

SIR HIRAM MAXIM has studied the subject of aerial flight these 50 years, and Macmillans are now bringing out a book by him on the subject which will be of universal interest.

MR. F. R. BRYANT, who for some time past has been general salesman of the Central Electric Company, Chicago, Ill., has severed his connection with the concern and is now associated with the Crescent Company.

MR. JOHN G. ROBERTS has resigned his position as head of the patent department of the Western Electric Company, Chicago, and is now engaged as a consulting electrical engineer and expert in patent causes.

MR. C. A. CHAPMAN, consulting engineer, Marquette Building, Chicago, has incorporated his business under the name "C. A. Chapman, Inc." Mr. Chapman is president of the new corporation and Mr. W. D. Chapman is secretary-treasurer.

MR. L. A. FERGUSON, president of the American Institute of Electrical Engineers, was the guest of the Urbana section of the institute at a meeting held in the physics lecture room, Engineering Hall, University of Illinois, on Jan. 15 at 4 p. m.

PROF. L. A. HERDT, of McGill University, has been retained by the City of Winnipeg, Man., to report on the electric lighting situation in Winnipeg and also to make a survey and report on the subject of electrolysis from electric railway current.

MAJOR E. L. ZALINSKI, president of the Bureau of Illuminating Engineering, New York City, has been seriously ill and is now in the New York Hospital, on West Fifteenth Street. He is suffering from an attack of pneumonia and his condition causes anxiety to his numerous friends.

MR. F. K. BRECKENRIDGE has been appointed superintendent of purchases and stores of the Waterloo, Cedar Falls & Northern Railway to succeed Mr. A. I. Breckenridge, deceased. Mr. F. K. Breckenridge's duties will include those of purchasing agent and general storekeeper, which positions have been abolished.

MR. W. C. BROWN, recently elected president of the New York Central lines, started his business career as a telegraph operator on a Western railroad at a salary of $35 per month. He has always been a hard worker, and his lifelong experience in railroading makes him eminently fitted to fill the high office to which he has been elected.

MR. HOMER HONEYWELL has resigned as general manager of the Lincoln (Neb.) Gas & Electric Light Company to take charge of the Freemont (Neb.) Gas Company, in which he is largely interested. His successor as manager of the Lincoln company is Mr. Ben. C. Adams, who formerly occupied the position of superintendent.

MRS. FRANCES A. W. McINTOSH, formerly advertising manager of the Buffalo Forge Company and its associate enterprises, has resigned, and has opened an office on her own account, where her services can be secured in the preparation of advertising literature of all kinds. Her new office is at 103 Anderson Place, Buffalo, N. Y.

MR. R. M. SEARLE has been appointed third vice-president of the Rochester Railway & Light Company, of Rochester, N. Y. Mr. Jas. T. Hutchings has been made general manager. Both promotions are well deserved. The other officers of this progressive company are H. E. Andrews, president; W. K. Vanderbilt, Jr., first vice-president, and G. A. Hollister, second vice-president.

MR. EDWARD C. BROWN, manager of the Honolulu office of the Dearborn Drug & Chemical Works, is making an extensive Oriental trip of three or four months, during which he will visit Japan, the important coast cities of China, Australia, the Philippines, Java and other important islands in the Pacific Ocean. Mr. Brown has succesfully handled the Dearborn company's business in the Hawaiian Islands since that department opened, some 10 years ago.

MR. AVERY P. ECKERT has issued an announcement to the electrical community that he has embarked in the railroad and electrical supply business at the Hudson Terminal Building, 50 Church Street, New York City. He is well known in the industry, with which he has now been connected a great many years, and, with his ripe experience and wide circle of friends and acquaintances, he has every prospect of building up a large and prosperous business.

MR. GEORGE N. TIDD, formerly general manager of the Scranton (Pa.) Electric Company, has resigned to become general manager of the American Gas & Electric Company, with offices at 30 Church Street, New York City. In this position he succeeds Mr. H. T. Hartman, who has been vice-president and general manager. Mr. Tidd is succeeded as manager of the Scranton company by Mr. L. H. Conklin, formerly general superintendent of the West Penn Electric Company, of Connellsville, Pa.

MR. F. A. WILLARD has resigned as commercial agent of the Rochester Railway & Light Company and will become general manager of the Red Wing Gas Light & Power Company, of Red Wing, Minn. Mr. Willard entered the employ of the Rochester company in January, 1906, organizing the commercial department which has done so much toward molding public opinion and popularizing electricity in that city. His resignation takes effect Feb. 1, and, following the policy of the company, some one in the commercial department will be promoted to the position made vacant.

MRS. G. WESTINGHOUSE.—Advices from Pittsburgh make the following announcement, which we understand to be correct as far as it goes: "The humanitarian instincts of Mrs. George Westinghouse and her great love for horses have resulted in her husband interesting himself

in the manufacture of an overshoe for horses which, it is hoped, will result in lessening the percentage of lame animals through preventing horses slipping on wet or icy streets. Arrangements have been completed here by A. G. Uptegraf, of Pittsfield, Mass., and the Westinghouse interests for the formation of a company to erect a large manufactory for horse overshoes. Mr. Westinghouse, it is said, has agreed to finance the concern one-third. George N. Kinnell, a veterinary surgeon of Pittsfield, Mass., inventor of the overshoe, will be president of the concern, while Mr. Uptegraf, who is here at present, will act as vice-president and treasurer."

Trade Publications.

D'OLIER ENGINEERING COMPANY, 119 South Eleventh Street, Philadelphia, has issued recently bulletins or leaflets devoted to steam turbines for direct and belted services, and horizontal centrifugal pumps. Both of these are illustrated.

M. B. AUSTIN & COMPANY, West Jackson Boulevard, Chicago, issued recently by the General Electric Company, illustrates and describes specialties, including Safety wire and cable, T. & B. conduit fittings, condulets, steel wall cabinets and other items and details of construction.

STROMBERG-CARLSON.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has just issued pamphlet No. 9 illustrative and descriptive of a number of rubber and composition parts for use with its standard telephone apparatus. Its object is to assist the purchaser of equipments of this make in ordering perishable parts. The cuts are actual size.

Business Notes.

THE C. H. GEIST COMPANY has removed its main offices from the Commercial Bank Building, Chicago, to the Land Title Building, Philadelphia.

SOUTHERN ILLINOIS ELECTRIC COMPANY, East St. Louis, Ill., has taken over the business of the American Vibrator Company, in addition to its lines of electrical supplies and electric railway, lighting and mining material.

REMOVAL.—The Economical Electric Lamp Company, manufacturer of turn-down lamps of that name, has removed from 96 Warren Street to 25 West Broadway, New York.

AMERICAN STEAM GAUGE.—The Southern branch of the American Steam Gauge & Valve Manufacturing Company, for several years located in the Equitable Building, Atlanta, Ga., has removed its office to 524-525 Candler Building, of that city.

BATTERY MAKING.—Mr. H. Chris Hansen, 19 Ransom Street, Muskegon, Mich., states that he is starting in the electrical manufacturing business and will make dry and storage batteries. He is in the market for brass parts, zins cans and other details.

WARREN WEBSTER.—Notice is issued that the business heretofore carried on by the American Engineering Specialty Company, in the West, will now be conducted in the name of Warren Webster & Company, with main offices and works at Camden, N. J.

NORTHERN APPARATUS.—The Northern Electrical Manufacturing Company, Madison, Wis., announces the enlargement and removal of its St. Paul district office to 1046 Security Bank Building, Minneapolis, continuing under the charge of Mr. T. E. Drohan as district sales manager.

FAN MOTORS.—The Independent Electric Machinery Company, Sheidley Building, Kansas City, Mo., will be glad to receive bulletins and prices on fan motors for both currents, of the ceiling, wall and desk types. It would also like prices on forge blower and other electrical specialties that can be handled to advantage in the territory. It is in the market for used electrical machinery.

GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., gives out the following list of recent sales of fans, blowers and exhausters: St. Joseph Railway, Light, Heat & Power Company, St. Joseph, Mo.; S. S. White Dental Manufacturing Company, Princes Bay, S. I.; New Bijou Theater Company, Atlanta, Ga.; American Manufacturing Company, Brooklyn, N. Y.; Masonic Building, Somerville, Mass.; People's Gas & Electric Company, Burlington, Ia.; U. S. Navy Yard, Mare Island, Cal.; General Storage Battery Company, New York, and scores of others in miscellaneous industries.

WAGNER POLYPHASE WATTMETER.—The Wagner Electric Manufacturing Company has placed on the market a portable polyphase wattmeter, which gives in a single indication the total power consumed in two-phase or three-phase circuits, as well as in single-phase circuits. Moreover, the instrument has the same accuracy on an unbalanced as on a balanced circuit. The Wagner line of switchboard and portable instruments now includes ammeters, voltmeters, power-factor indicators, frequency meters, wattmeters, ground detectors and synchronism indicators, together with current and potential transformers for all capacities, voltages and frequencies and any character of service.

HARVARD ELECTRIC COMPANY, Chicago, reports that the new Harvard patent galvanized channel steel bracket has met with deserved success since it was placed on the market a few months ago. The firm has sent out a number of brackets on approval and has received orders and testimonials relative to its serviceable qualities. This line includes steel construction material for telephone, telegraph, electric light and power transmission work in the way of brackets, foot and corner straps, pole fixtures, construction tools, etc. Mr. Allen L. Haase, for years actively identified with the steel bracket industry, is now sales manager of the company, 66 West Van Buren Street, Chicago, and 136 Liberty Street, New York City, and is paying particular attention to the bracket end of the Harvard business.

A NEW HEATING ELEMENT.—Mr. Walter G. Clark, president of the Parker-Clark Electric Company, states that its open-air burning filament described in *Electrical World* of June 27, has proved of great value as a "heater" for use in electric flat-irons, cookers, grills and all sorts of heating utensils; also for melting pots, for tin, lead, zinc, etc., and for heating varnish and other inflammable compounds, and for luminous electric radiators and electric heating devices of every description. This filament possesses many remarkable qualities. It can be plunged, while burning, in ice water or placed in contact with ice without in any way affecting it other than reducing its temperature. It will withstand a temperature up to 1500 deg. C.; its resistance is 50 times that of carbon of equal cross-section, and it can be made up in any size and in any shape required. On account of its high resistance, a number of these filaments or heaters may be used in parallel. In the laboratory the filament has burned in the open air at a bright heat for upward of 1000 hours, it is stated, with no apparent deterioration. This filament operates equally well on either direct or alternating current and it can be made for any voltage. Used as a heater, it absorbs approximately 75 volts per inch of length when in the filament form, using ½ amp or less.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 12, 1909.

[Conducted by William F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

909,136. DYNAMO-ELECTRIC MACHINE; Bernard Arthur Behrend, Norwood, Ohio. App. filed Nov. 27, 1905. Relates to rotating field alternators with air cooling of the armature by fan segments secured to the field.

909,146. RELAY; John P. Buchanan and F. B. Wiegand, Cleveland, Ohio. App. filed July 18, 1907. Relay for railway block signal in which the harmful of current leakage are eliminated, which retains the armature of the track relay closed. A magnet breaks the circuit controlled by the relay, the energization of the magnet being controlled by movement of the armature of the relay.

909,158. BLOCK-SIGNAL SYSTEM; F. B. Corey, Schenectady, N. Y. App. filed March 30, 1908. Three position signals with a motor for moving the arm, contacts actuated by the arm for controlling the signal next in the rear, and means for rendering the contacts inoperative when the motor is in operation.

909,192. ELECTRIC ALARM BELL; Nikolaus Kessler, Ragusa, Austria-Hungary. App. filed May 27, 1907. The bellhanger is held by two spring arms which carry an armature controlled by the magnet; the arms release the bell hammer, which avoids any unintentional ringing of the bell in consequence of shaking or other vibration.

909,193. ALTERNATING-CURRENT MOTOR; M. C. A. Latour, Paris, France. App. filed Aug. 17, 1907. Commutator type of motor in which the current in the short-circuited armature coils is counterbalanced by a commutating field produced by two voltages, of which the smaller increases with the speed.

909,197. DYNAMO-ELECTRIC MACHINE; Matthew William Walbank Mackie, Ealing, England. App. filed July 24, 1907. The voltage of the dynamo is maintained constant by a demagnetizing winding and a secondary battery opposing the flow of the current there through, with means to supplement the e.m.f. of the battery so as to alter the voltage of the dynamo without altering the demagnetizing winding.

909,198. COMBINED TELEGRAPH RELAY AND SOUNDER; A. J. Meyer, Milwaukee, Wis. App. filed Sept. 19, 1907. Increases the loudness of the sounder by providing a horn and box to increase the sound.

909,201. ELECTRIC CONTROLLING AND SIGNALLING SYSTEM FOR RAILWAYS; H. Earle McDonnell, Leominster, Mass. App. filed Aug. 7, 1906. A third-rail or trolley system in which the third rail is disposed between the rails of the track and divided into sections with electromagnetic stopping means upon the vehicles and a plurality of fixed devices to automatically set the stopping means on each vehicle for direct or reverse effect.

909,216. MEANS FOR STARTING DYNAMO-ELECTRIC MACHINES; W. D. Pomeroy, Norwood, Ohio. App. filed May 17, 1906. Electro-mechanical means for starting a synchronous motor by means of a pump and an auxiliary motor.

909,247. TROLLEY-POLE FASTENING; O. L. Spry, Des Moines, Ia. App. filed Sept. 16, 1907. A tubular pole fits in a socket, and is held therein by a pin and slot.

909,309. APPARATUS FOR GENERATING OZONE; W. Kolle, Stuttgart, Germany. App. filed Feb. 12, 1908. Comprises a casing and a plurality of tubes within the casing with ozoning conductors within the tubes.

909,311. AUTOMATIC SPRINKLER ALARM AND INDICATOR; F. W. Milliken, Auburn, Maine. App. filed Dec. 30, 1907. A valve with a closed chamber adjacent to the valve; a gear in the chamber which, when rotated, will close the contact and ring a signal.

909,326. ELECTRIC-LAMP RECEPTACLE; G. L. Patterson and J. B. Farrell, New York, N. Y. App. filed Aug. 10, 1907. Avoids short-circuiting when the lamp is used in outdoor work by providing drainage canals in the porcelain base.

909,335. THIRD-RAIL ANCHORAGE; W. B. Potter, Schenectady, N. Y. App. filed Sept. 7, 1907. Prevents creeping of the rail, by means of clamps secured to the rail bolts located beneath the rail and extending from the clamps to the roadbed and an insulator in each bolt.

909,356. TELEPHONE-TRANSMITTER ATTACHMENT; J. S. Wincrantz, Pittsburg, Pa. App. filed Aug. 12, 1908. In order to temporarily stop the transmitter from working, instead of placing the hand over the mouth, a brake is forced into engagement with the diaphragm to prevent its vibrating.

909,367. POTENTIAL STARTER ATTACHMENT; W. W. Cheney, Norwood, Ohio. App. filed Sept. 29, 1906. For induction motors.

909,448—Cable Hanger.

Comprises a controller with a handle and a latch thereon and a fixed plate coacting with the latch to prevent backward movement of the handle.

909,382. ELECTRICAL-IMPULSE-TRANSMITTING DEVICE; J. Erickson, Chicago, Ill. App. filed Aug. 20, 1906. Make-and-break device for calling, provided with a rotatable dial and a retarding device for resisting the backward rotation of the dial when an attempt is made to manually force the dial to its normal position.

909,383. ELECTRICAL-IMPULSE-TRANSMITTING DEVICE; J. Erickson, Chicago, Ill. App. filed Aug. 20, 1906. Positively locks the rotatable dial against backward rotation as soon as the stop which limits the forward rotation of the dial is engaged by the calling subscriber's finger.

909,403. SWITCHING DEVICE FOR PARTY-LINE EXCHANGES; W. Hagstrom, Lindsborg, Kan. App. filed June 11, 1906. A mechanism which performs all the useful functions of the ordinary switching mechanism and its associated magnet, at the same time disposing of that magnet and its circuit.

909,414. TELEGRAPHONE APPARATUS; E. A. Hytten, Copenhagen, Denmark. App. filed Dec. 31, 1907. By means of the apparatus, the person dictating can control the advancement, reversal and stopping of the telegraphones at different points on the line and can hear the parts which have been dictated. The telegraphone comprises a wire passing between spools, a power shaft and clutches with suitable magnets.

909,417. ELECTRIC SELF-WINDING CLOCK; H. O. Jackson and H. C. Vizents, Chicago, Ill. App. filed April 24, 1908. The spring driving the clock train is automatically wound by an electromagnet. Details.

909,418. ELECTRIC SECONDARY CLOCK; H. O. Jackson and H. C. Vizents, Chicago, Ill. App. filed June 10, 1908. Relates to secondary clocks driven by a master clock, in which a worm gear guides the minute hand, thus locking it against accidental movement.

909,428. ELECTRODE OR PENCIL FOR ARC LIGHTS; I. Ladoff, Cleveland, Ohio. App. filed May 27, 1908. The upper electrode of carbon has a central core of iron and the negative electrode comprises ferric and titantic material.

909,433. APPLIANCE FOR ELEVATORS AND OTHER MOVABLE OBJECTS AND BODIES; Adam Lungen, New York, N. Y. App. filed Jan. 30, 1908. Indicates the failure to close the door before the car has left the landing, by means magnetically displaced by the movement of the car.

909,438. INCANDESCENT LAMP; M. M. Merritt, Middleton, Mass. App. filed Feb. 24, 1906. Prevents repairing old lamps and selling them as new by providing means independent of the filament fastening, such as a guard to hinder access to the end of a leading in wire.

909,448. CABLE HANGER; C. L. Peirce, Jr., Chicago, Ill. App. filed May 31, 1905. The hanger includes a hook which does not require manipulation to render it non-detachable from the supporting wire.

909,481. TERMINAL CONNECTOR; W. C. Tregoning, Hackensack, N. J. App. filed Oct. 22, 1906. The connector comprises two members joined together and resiliently movable away from each other, the free ends of the members having suitable openings to engage the terminal post.

909,485. SELF-WINDING CLOCK; C. W. Wagner, Danville, Pa. App. filed April 30, 1908. When the motor spring runs down it closes the circuit which automatically causes the rewinding of the spring. Details.

909,503. CLOCK SYSTEM; E. E. Yaxley, Chicago, Ill. App. filed Oct. 26, 1908. A clock system in which a master clock controls secondary clocks designed to improve the synchronizing of the clocks by suitable circuits and switching mechanism.

909,511. QUADRUPLEX TELEGRAPH SYSTEM; E. J. App, Lynchburg, Va. App. filed Sept. 23, 1907. Reduces sparking at the pole changer by means of an artificial line. Details.

909,551. SIGNAL APPARATUS; C. J. Coleman, Rockaway, N. J. App. filed July 8, 1901. Operates a normal safety system by means of a local storage tank of liquified carbonic acid gas.

909,564. ELECTRIC FUSE; Louis W. Downes, Providence, R. I. App. filed Dec. 15, 1903. A plug fuse with a cup-like casing and a main fuse wire enclosed within the casing, together with indicating means for indicating the condition of the fuse.

909,566. TELEPHONE TRANSMITTER; J. B. Edwards, Chicago, Ill. App. filed May 5, 1905. Omits the usual large flexible diaphragm and provides a granule-containing chamber with suitable means for preventing packing.

909,569. TROLLEY-WIRE SUPPORT OR HANGER; C. G. Ette, St. Louis, Mo. App. filed May 4, 1908. A trolley-wire support in which the jaws that carry the wire are perfectly insulated from that portion of the support which is connected to the guide wire which sustains the support. Details.

909,572. SECONDARY BATTERY; L. H. Flanders, Wilkinsburg, Pa. App. filed April 15, 1905. A separator for battery plates which prevents bridging of the active material, comprising a perforated sheet, having a plurality of integrally formed spacing strips.

909,584. TROLLEY; E. H. Green, Emeryville, Cal. App. filed Sept. 13, 1907. A yoke having arms provided with bearings, whose extremities are returned to overlie the bearings, together with a roller journaled in the bearings and guards connected with the return portion of the arms.

909,594. SPARK COIL; J. O. Heinze, Jr., Lowell, Mass. App. filed June 3, 1908. A tension device for the armature spring which prevents the tension exceeding a predetermined amount, thus limiting the amount of current passing through the primary of the coil.

909,627. THERAPEUTIC LAMP; E. W. Locke, Chicago, Ill. App. filed Sept. 16, 1908. Avoids overheating of the lamp by interposing a non-conductor of heat between the two bodies which form the attaching medium for the lamp.

909,651. SELECTIVE ELECTRIC SIGNALING; A. H. Nicholson, Wendover, England. App. filed Feb. 20, 1908. A polarized relay which fulfils the function of a non-polarized relay by providing two relay contacts in series with each other, which are normally closed. If either contact is interrupted, the circuit is broken.

909,666. PROCESS OF OBTAINING NICKEL FROM SILICIOUS ORES; E. F. Price, Niagara Falls, N. Y. App. filed July 29, 1907. Makes ferro-nickel, by smelting a silicious ore, by means of an electric arc and protecting the electrode by a large body of the charge.

909,667. PROCESS OF OBTAINING NICKEL FROM SILICIOUS ORES; E. F. Price, Niagara Falls, N. Y. App. filed July 29, 1907. Makes ferro-nickel by heating a suitable charge by means of an electrically heated resistance conductor.

909,673. BATTERY PLATE; G. B. Rinehart, Ashland, Wis. App. filed Feb. 4, 1908. The grid includes a rim with an integral tongue. The front and back bars of the grid are staggered with relation to each other.

909,691. HANGER FOR TROLLEY WIRES; H. Schutte, Wheeling, W. Va. App. filed Sept. 12, 1907. The hanger comprises a central socket portion with elastic shanks and longitudinal jaws extending from the shanks.

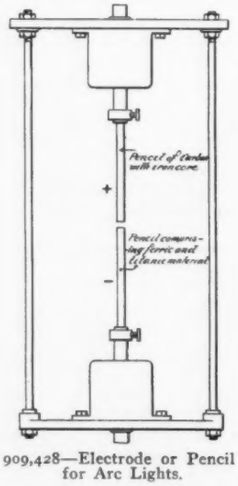
909,702. TELEPHONE TRANSMITTER; S. A. Steinbarger and R. L. Steinbarger, Augusta, Ill. App. filed July 16, 1907. A main diaphragm with an auxiliary diaphragm originally secured thereto, the latter movable bodily and a rear electrode carrying a multiplicity of cells with granular material therewithin.

909,732. ELECTRIC SECONDARY CLOCK; H. C. Vizents, Chicago, Ill. App. filed Sept. 21, 1908. A noiseless electric secondary clock, in which the hands are turned by means of a worm gear. Details.

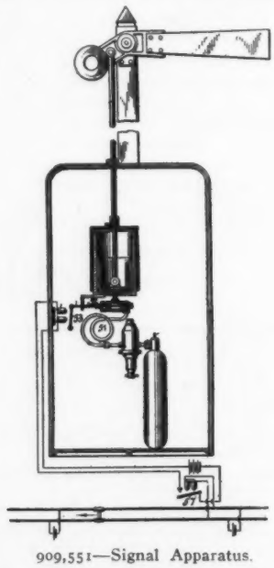
909,742. SWITCH; R. W. Borchert, St. Louis, Mo. App. filed Dec. 16, 1907. A switch in a lamp socket which is actuated by a revoluble ring encircling the switch. Details.

909,811. PROCESS FOR EXHAUSTING LAMPS; M. M. Merritt, Middleton, Mass. App. filed Jan. 27, 1905. Places a volatile chemical agent within the bulb, then exhausts, then incandesces the filament, then seals the bulb and completes the volitalization in the presence of the incandescent filament.

909,812. INCANDESCENT LAMP; M. M. Merritt, Middleton, Mass. App. filed Feb. 24, 1906. Avoids repairing lamps by irresponsible persons and selling them as new by making one of the leading-in



909,428—Electrode or Pencil for Arc Lights.



909,551—Signal Apparatus.

wires relatively weak near the stem, so that the latter will break off close to the stem in attempting to repair the parts.

909,813. BATTERY-DISCHARGE REGULATOR; E. J. Murphy, Brooklyn, N. Y. App. filed June 9, 1908. Protects primary batteries from abnormal rates of discharge by introducing a circuit breaker control from the working circuit, with mechanical means whereby the time limit of the action of the retardation may be adjusted.

909,818. THERMO-ELECTRIC ALARM; J. E. Paul and J. M. Stewart, Denver, Col. App. filed Nov. 30, 1906. A closed container containing air on one side of which is a flexible diaphragm that operates a circuit closer. Details.

909,834. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; Miles Walker, Hale, England. App. filed March 23, 1908. For machines with grooved commutators, comprising a frame with guide projections that produce a lateral recess near one extremity and brush blocks moving in the recess and pressed on by a spring.